

The Chemical Age

A Weekly Journal Devoted to Industrial & Engineering Chemistry

VOL. III.

AUGUST 28, 1920

No. 63

Contents

| | PAGE |
|--|------|
| Editorial Notes: Developing Colonial Trade; Industry's Debt to Research; Fuel Economy; Government Shares in Dyes and Oils; Exporters' Views on Trade ... | 223 |
| The Calendar | 225 |
| Colonial Trade: Views of Exporters; Chemical Industry in the Colonies ... | 226 |
| Union or Disunion (Antimony Tartrate) ... | 228 |
| Researches into Metallic Alloys: Presidential Address, by C. T. Heycock, M.A., F.R.S. | 229 |
| British Association Meeting at Cardiff ... | 233 |
| Fuel Economy: B. A. Committee's Third Report | 235 |
| From Week to Week ... | 239 |
| References to Current Literature ... | 240 |
| Patent Literature ... | 241 |
| Market Report and Current Prices ... | 244 |
| Company News ... | 247 |
| Commercial Intelligence ... | 247 |

Index to Advertisers, see page iii.

NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Other communications relating to advertisements or general matters should be addressed to the Manager.

The prepaid subscription to "The Chemical Age" is 21/- per annum for the United Kingdom, and 26/- Abroad. Cheques, P.O.O.'s, and Postal Orders should be payable to Benn Brothers, Ltd.

Editorial & General Offices—8, Bowyer Street, London, E.C.4.
Telegrams : "Allangas, Fleet, London." Telephone : City 9852 (4 lines).

Developing Colonial Trade

THIS is our first annual Colonial Number. Its contents will reach a very wide constituency of buyers interested in chemical industry and chemical engineering, and already manufacturers and merchants realise the value of this convenient way of making their products known throughout our Colonies and Dependencies. The field is one almost without limit. All our Colonies are still in the early stages of development. In the extension of their agricultural, mining, metallurgical and general industries applied chemistry must play an ever-increasing part, while chemical plant also will be needed in steadily growing quantities, if the vast natural resources of the countries are to be commercially developed. These needs must be satisfied from some source, and it depends mainly on ourselves whether we or rival nations are to satisfy them. In the past foreign products found their way into Colonial markets to a larger extent than was desirable. The

war brought the Colonies and the Motherland into a friendlier and more intimate relation than ever existed before. The unity of sentiment and the desire for fuller intercourse have not yet passed. They constitute an atmosphere favourable to trade. There never was a better opportunity for extending business with our own people in the Overseas Dominions. But Britain must make the necessary effort, and take account of the essential conditions. Some of the latter may be briefly noted now.

It has become almost a commonplace to say that our primary need is production. Our Colonies are suffering from a scarcity of the necessities of civilisation as much as we are at home. The supply generally is not yet equal to the demand. Consequently prices are high, trade is restricted, and the much desired return to normal conditions is retarded. The remedy lies in freer production of world necessities, so that trade and industry may go forward, and the threatened unemployment be averted. A considerable period of unrest after the war was to be expected. The feeling of unsettlement still remains, but gradually it is diminishing. Though the strike fever is still with us, on the whole we think the tendency is towards settling down to work. The tendency, we are sure, is increasing among the body of workpeople, in spite of the rather reckless behaviour of some of their leaders. Even among the latter it is beginning to be realised that nations cannot live on heroics. If we are to make up for our huge losses it can only be by sober work, and the nations that soonest settle down to work will be the nations to go forward.

The next need is a more thorough study of the immense markets offered by our Overseas Dominions, the adaptation of our products to their special needs, and adequate provision for letting Colonial buyers know what we can supply. It has been said that the British are the best producers in the world; but that they have much to learn from other nations in the art of sale and advertisement. It is a great tribute to the quality of British products that they have been able to sell themselves so well on their intrinsic merits. But there is no reason why they should be handicapped in the matter of sale as compared with foreign goods. We are gradually learning in this respect, and the concerted steps now being taken to make British productions better known will gradually have its effect.

A third condition is convenient and reasonably cheap transport and shipping facilities. We have already commented on the heavy handicap which the new scale of railway charges must impose on home industries. Our export trade, if commercial opinion is to be trusted, is not less hampered by the conditions imposed on merchanting firms by shipping companies.

We have heard of cases where the *ad valorem* rates simply make new business impossible, and cut the British merchant out of markets open to the foreigner. In some cases the companies refuse to state what rates—whether measurement, tonnage, or *ad valorem*—are to be charged until the goods are aboard, though the difference between one rate and another may represent the difference between a profit and a loss. The Board of Trade is not unaware of these difficulties. Its attention has been drawn to it from several quarters. The Chemical & Dyestuffs Traders' Association are already taking vigorous action in respect especially of *ad valorem* freights to certain ports. The Board of Trade, however, has no direct authority to intervene in the case of the shipping companies, though the indirect influence it might bring to bear could hardly be without effect. The truth is that the shipping companies are masters of the situation, and only by the combined action of the whole trading community are they likely to be influenced.

Finally, we should regard as an essential condition the development of loyal collective action among the merchant class throughout the country. Individualism is an important British characteristic, but it has been overdone. It has led to isolation and jealousies which are not good for trade, and the merchant interest, unless it is well organised for its own protection, must inevitably suffer in competition with other better organised interests. Yet the British merchant seems disposed to let matters drift. He cannot pursue the policy without paying the penalty, which with increasing Government regulation of trade may prove a heavy one. If he is wise he will join with his brethren in putting the merchant class in as strong a position as the manufacturers, and his contribution to his association funds should be as indispensable a provision for his own protection as his annual insurance premium is against fire. Not until the merchants realise their corporate relation and take steps for collective action will they be in a position to secure justice for themselves.

Industry's Debt to Research

THE address of Mr. C. T. Heycock, the president of the Chemical Section at the British Association at Cardiff, ended where so many of such discourses almost inevitably end nowadays, namely, on the material and commercial benefits which ultimately spring from pure research work in the laboratory and on the necessity, in the interests of national progress, for adequate financial provision for the continuance of such work. The address took the form of a historical review of the researches into the metallic alloys during the last thirty or forty years, researches in which British chemists may claim an honourable share. As the president pointed out, large numbers of the elements and their compounds which originally were laboriously prepared and investigated in the laboratory and remained dormant as chemical curiosities for many years have now taken their places as important and, indeed, essential articles of commerce. Mr. Heycock, during his own lifetime, has seen a vast number of substances transferred from the category of rare laboratory products to that which comprises materials of the utmost

importance to the modern metallurgical industries. A few decades ago aluminium, chromium, cerium, thorium, tungsten, manganese, molybdenum, nickel, calcium and calcium carbide, carborundum, and acetylene were unknown outside the chemical laboratory of the purely scientific investigator; to-day these elements, their compounds and alloys, are among the most valuable of our industrial metallic products, and are essential to many forms of industry.

The point which Mr. Heycock properly emphasised was that all these metallic elements were discovered and their industrial uses foreshadowed in the course of the purely scientific research work carried out in universities, colleges, and similar institutions, and are to-day the basis of great and lucrative industries. It is encouraging to find that the dependence of industry upon this pioneer work done in the laboratory—often with little idea of what may eventually come out of it—is becoming increasingly recognised by our great companies as well as by individual donors. But the recognition needs to become far more general and far more generous, and a great educational work remains to be done before the capitalist and the organiser on the one side, and the manual worker no less on the other realise how much the industries by which they live rest on the quiet and devoted work of the men engaged in research.

Equally timely was Mr. Heycock's closing reminder that our most pressing need to-day is the cultivation of a better understanding between all engaged in productive industry. If, as he says, by reason of turbidity of vision, our large manufacturing corporations fail to see that in their own interest the financial support of purely scientific research should be one of their first cares, technical advance will slacken, and other nations, adopting a more far-sighted policy, will forge ahead in science and technology. Especially would our industrial classes, more insistent on their rights than conscious of their communal obligations, be the better for catching something of the devoted spirit in which our great scientific minds have worked patiently and laboriously and so often with a complete disregard of self for the progress of knowledge, and for realising that, to quote the president's closing sentence, "in closer sympathy between all classes of productive labour, manual and intellectual, lies our only hope for the future."

Fuel Economy

THE third report of the Fuel Economy Committee appointed by the British Association puts very pointedly the serious position as regards the increased cost and the reduced volume of coal production in this country. The pit-head price per ton of coal raised in 1913 was 10s. 1½d.; the corresponding price in 1919 was 26s. old., though, in the meantime, the owner's profit per ton had shrunk from 1s. 5d. to 1s. 2d. The estimated average cost this year is 27s. 3½d. per ton, so that since the outbreak of war the pit-head cost of coal has nearly trebled. In a country where coal is the basis of national industry the increase presents a grave industrial problem.

Coupled with this is an alarming shrinkage in our exports of coal. Appendices are attached to the report

showing the tons of coal exported from the United Kingdom in each of the years 1913 to 1919, distinguishing the principal countries to which consigned. The total exports to foreign countries have declined from 67,919,000 tons in 1913 to 31,043,200 tons in 1919. The total exports to British possessions have declined from 25,481,118 tons in 1913 to 4,206,368 tons in 1919. The total decrease is from 73,400,118 tons in 1913 to 35,249,568 tons in 1919. The following table shows the figures for various districts:—

| | 1913. | 1919. |
|---------------------------------|------------|------------|
| Bristol Channel Ports | 29,875,916 | 20,229,802 |
| North-Western Ports | 751,819 | 86,728 |
| North-Eastern Ports | 23,023,810 | 11,701,435 |
| Humber Ports | 8,883,353 | 530,471 |
| Scottish Ports { East Coast ... | 8,253,023 | 1,905,176 |
| West Coast ... | 2,184,174 | 745,899 |
| Total..... | 73,400,118 | 35,249,568 |

It is obvious that this problem is one of the most serious confronting the nation.

In addition to a memorandum by Professor Henry Louis on the preparation of complete coal mining statistics, there is an interesting note, together with a memorandum by Professor Bone, on the Skinningrove process for the production of alcohol from coke oven gas. The experiments conducted by Mr. E. B. Bury, in conjunction with Mr. O. Ollander, have demonstrated the possibility of obtaining on a large scale 1·6 gallons of absolute alcohol per ton of the particular Durham coal carbonized. Assuming a similar yield from the 15,000,000 tons (or thereabouts) of coal now annually carbonized in British by-product coke ovens, it is claimed to be possible to obtain from coke works alone a 95 per cent. industrial alcohol in quantities equivalent to about 24 million gallons per annum of the absolute spirit.

Government Shares in Dyes and Oils

A RETURN has just been issued showing the amount of public money invested in registered companies by the Government. The total so invested is £18,000,000, and the concerns among which it is distributed include dyes, oil, nickel, shipping, sugar and cellulose. The details are given below:—

| | £ | s. | d. |
|---|--------------------|-----------|----------|
| British Farina Mills, Ltd. | 325,000 | 0 | 0 |
| British Dyestuffs Corporation, Ltd. | 1,700,001 | 0 | 0 |
| Turkish Petroleum Co. | 22,105 | 5 | 0 |
| British America Nickel Corporation (of Canada) | 629,618 | 6 | 1 |
| The Standard Shipbuilding & Engineering Co., Ltd. | 656,250 | 0 | 0 |
| Suez Canal Co. | 4,050,000 | 0 | 0 |
| Cunard Steamship Co. | 2,600,020 | 0 | 0 |
| Anglo-Persian Oil Co. | 5,200,000 | 0 | 0 |
| Home Grown Sugar, Ltd. | 187,500 | 0 | 0 |
| British Cellulose & Chemical Manufacturing Co., Ltd. | 1,450,000 | 0 | 0 |
| Commercial Bank of Siberia | 1,198,371 | 8 | 7 |
| | £18,018,865 | 13 | 8 |

The amount is probably larger than most people had supposed, and the bulk of it has been invested since 1914. The tendency, therefore, is a modern one, and is apparently on the increase. There may be special circumstances to account for and even justify these transactions, but they are regarded from the public

point of view with a certain amount of misgiving, and it is certainly to be hoped that the habit of investing State funds in private enterprises will not be allowed to grow.

Exporters' Views on Trade

THE communications published on p. 226 from several firms of chemical merchants on the question of export trade may be taken as typical of the attitude of British merchants. It is generally agreed that there is something of a lull in trade, that markets are extremely sensitive, and that commercial opinion, owing to the unsettled conditions, is apprehensive as to the future; on the other hand, as one of our correspondents puts it, it would not take much increased demand to bring revived activity and some reaction in prices. The high cost of transport and shipping has now become a commonplace. Mr. F. T. T. Reynolds, one of the governing directors of Millwards Merchandise, Ltd., refers particularly to the shipping companies' policy of applying "exorbitant and indefensible freights on an *ad valorem* basis." These, he states, run as high as 3 per cent., plus 10 per cent. prime, and total in some cases over £50 per ton weight against a pre-war rate for the same service of 37s. 6d. per ton. Messrs. R. W. Greeff & Co. concisely summarise the situation in the statement that "what is required to assist in the extension of business is, in the first place, the abolition of the Excess Profits Duty, which stifles enterprise; secondly, freedom of industry to look after its own affairs without Government interference; and, above all, a cessation of labour disputes, which have become a veritable menace to the industrial life of our nation." While one of our correspondents credits—or debits—Customs officials with the possession of an unusual quantity of red tape, an opinion of which one could readily find confirmation, it is pleasant to find another acknowledging the Department of Overseas Trades' "genuine and really useful effort in the development of British trade abroad." This opinion also is not a solitary one. Business people are finding the approachable attitude of the Overseas staff a pleasant contrast to the more austere manners of the two Departments which it links together.

The Calendar

| | | | |
|-------|---|--|--|
| Sept. | | | |
| 1 | Institution of Petroleum Technologists: 'Oil Prospecting,' by G. Howell. 6 p.m. | Canada Building, Crystal Palace, London. | |
| 15-16 | The Institute of Metals: Autumn Meeting. | Barrow-in-Furness. | |
| 21-24 | Iron and Steel Institute: General Meeting. | Cardiff. | |
| Oct. | | | |
| 1 | Society of Chemical Industry (Manchester Section): "The Structure of the Molecule in Crystalline Solids," by Professor W. L. Bragg. | Grand Hotel, Manchester. | |
| 9 | Mining Institute of Scotland: General Meeting. | Edinburgh. | |
| 18 | Physical Society of London and Faraday Society (Joint Meeting): "The Physics and Chemistry of Colloids." | London. | |

Colonial Trade: Views of British Exporters

For the first annual Colonial Number of THE CHEMICAL AGE we invited the views of a few representative British firms interested in chemicals or chemical engineering on the question of Colonial trade, especially in regard to transport and shipping problems, the effect of Government regulations, and the steps to be taken for extending trade with our Colonies. The following are among the replies received.

Millwards Merchandise, Ltd., Manchester

At the moment there is a lull in demand for chemicals and dyestuffs. Prices generally have somewhat abated, but there is still a scarcity of certain articles, and markets are very sensitive. It must be borne in mind that almost any commodities, either manufactured or imported, available at less than 100 per cent. advance upon pre-war prices are relatively cheaper than before the war. Chlorate of soda may serve as an illustration. At anything less than 6d. per lb. it is cheaper than at 3d. in the early part of 1914. Costs of raw material, coal, labour, services, packages, transport, insurance, rates and taxes, &c., combine at least to double the cost.

It would not take much increased demand to bring revived activity and some reaction in prices. The world's imperative needs are still far from covered. Restricted credits and indiscriminate realisation of stocks have produced a somewhat unreal position. Easement in price of some articles raised expectancy of a general and continued downward movement. This and the heavy burden on trade of an undue proportion of taxation are causing most firms to work on small stocks. Should the expected resumption of trade with Northern Europe come about during the next few months, sufficient impetus may be given to cause a sharp revival of activity and a decided upward movement in prices.

The difficulties of the moment are accentuated by transport and shipping delays and irregularities, and the constant menace of labour troubles. Railway rates and charges in the United Kingdom threaten to become—if they are not already—the highest in the world, and some of the shipping companies continue to apply exorbitant and indefensible freights on an *ad valorem* basis. These run as high as 3 per cent., plus 10 per cent. primage, and total in some cases over £50 per ton weight, against a pre-war rate for the same service of 37s. 6d. per ton. This constitutes a serious handicap to British traders, and is a severe restraint on trade. There are three Government Departments interested—the Board of Trade, the Department of Overseas Trade and the Ministry of Shipping—and all are apparently impotent in the matter. Shipping rates should be somewhat modified as and when the shortage of tonnage is redressed, and some relief in transport charges will ensue from the great increase in motor haulage on the roads.

The proposals of the Government in the Imports and Exports Restriction Bill, expected to be introduced when Parliament reassembles in the autumn, will be of great interest to the chemical and dyestuffs trades, and will be very closely scrutinised, and, if necessary, acutely criticised. The fear is that too much power will be vested in official controls, and that aspects of vital interest will be dealt with by departmental orders and actions, instead of by the application of definite principles fully considered and properly sanctioned by Parliament. Nothing could be more objectionable in theory or more pernicious in practice than legislation conceived in secret conclave and administered by a hidden hand. The trades concerned are keenly alive to the importance of the United Kingdom being as far as possible self-contained in the production of essential manufactured dyestuffs and chemicals; but action should be the outcome of the fullest possible consideration, especially in concert with instructed experience. If the problem is rightly handled, the United Kingdom will

soon be able to produce and supply with advantage to buyers in both price and quality all the essential requisites in dyestuffs and chemicals of the whole British Empire, and with a surplus for general exportation.

FREDK. T. T. REYNOLDS,

R. W. Greeff & Co., London

The early part of this year witnessed an unparalleled demand from every Colonial market for British manufactures of all descriptions; but, as is well known, the volume of business passing during the last two or three months shows a very considerable diminution, and a lack of confidence is evident the world over. This is perhaps due to the recent wave of speculation, with its consequent over-trading, which has forced prices up in many cases to a level which buyers regard as entirely fictitious. In view, however, of the fact that the world-wide shortage of supplies, due to the war, has not yet been met to any extent, it is probable that the present setback will only be of limited duration, and that we may expect a revival in demand as the autumn approaches.

What is required to assist in the extension of business is, in the first place, the abolition of the excess profits duty, which stifles enterprise; secondly, freedom for industry to look after its own affairs without Government interference; and, above all, a cessation of the labour disputes, which become a veritable menace to the industrial life of our nation.

A. F. B.

Perry & Co. (Bow), Ltd., London

Relying to your inquiry, the following are our views on the above subject in so far as this Department (gas) is concerned:

1.—Very few Colonial inquiries have been received during the last six months.

2. *Transport and Shipping Facilities.*—Our experience in this direction shows facilities are good, but freight rates extremely high. Over and above the freight, the Port of London Rates have to be taken into consideration, and these have been increased 150 per cent. on pre-war figures.

Again, owing to high cost of the necessary materials and labour, the cost of packing our class of goods for export adds from 50 to 75 per cent. to the actual cost of the goods.

3. *Government Regulations.*—No effect of these have so far been felt. The Customs officials, however, appear to be in possession of an unusual quantity of red tape.

4. *Development of Colonial Trade.*—As far as we are concerned this is at a standstill, and until more favourable conditions prevail we cannot see any hope of further development.

Peter Brotherhood, Ltd., London

In reply to your letter asking for our views on the present condition of Colonial Trade, we find that the chief handicap in the development of business abroad is the uncertainty of estimating cost of production for any length of time ahead, owing to the continuous demands for increase of wages, and the continual rise in the cost of coal and steel. The result is that in fixing prices for export either a clause protecting the manufacturer against increased costs, must be inserted or an addition made to the ruling price to cover possible increase of cost during the period of manufacture.

In the first case the agent or exporter is liable to lose the whole of his profit or even make a loss on the transaction, and in the second the makers prospects of business are prejudiced in comparison with offers from countries where the conditions are more stable. We must say that we find the Department of Overseas Trade making a genuine and really useful effort in the development of British trade abroad.

Chemical Industry in the Colonies

Australia

There is now a chemical industry established in Australia, and it seems likely to assume large dimensions in the near future. The impetus to manufacture certain chemicals was given during the war, when the importation of sheep-dip had practically ceased. This article is necessary to the carrying on of the staple industry of the Dominion, so that the Government was forced to stimulate and to encourage local manufacture. The latter months of the war found several firms, such as that of Victor Leggo, established and capable of supplying the majority of the sheep-dip demanded by the country, and now the Government finds itself morally responsible for the maintenance of an industry with such a potential value. After the war these firms seem to have turned their attention to the manufacture of other high-grade arsenical compounds and chemicals of an industrial character, and are reported to be progressing as well as can be expected against all the difficulties inherent to a newly-established industry.

Statistics of the latest developments are not available, but from the most recent we learn that between 1914 and 1917 there were 36 new drug and chemical factories established in the Commonwealth.

Tariff

The revision of the new Australian tariff, which became effective from March 24th last, is about to be undertaken by the Commonwealth Parliament. It is expected that the greater part of the current session will be occupied with the discussion of the new duties. The Commonwealth Labour Party supported Protection at the last elections, its fiscal attitude being influenced by the belief that the protectionist tariff would create profitable employment for the workers, and at the same time have a steady influence on the trend of prices of necessary commodities. New industries like the chemical industry, however, that have come into existence mainly in consequence of the barrier against outside competition, do not absorb an appreciable quantity of surplus labour, neither do they contribute notably to the relief of prices, but the effect of a new tariff will have obvious results in favour of British exporters of chemicals.

In December, 1920, Proclamations were issued prohibiting exports to and imports from Germany, Austria-Hungary, Turkey and Bulgaria unless the consent in writing of the Minister of Trade and Customs had first been obtained.

Industrial Metals

The policy of the Commonwealth Government is to have all metallic ores, as far as possible, treated within the Commonwealth, so that the resultant metals can be marketed in a refined state. The Australian Metal Exchange, formed in 1915, controls the export of metals and minerals (except gold, silver and platinum).

LEAD.—Three companies have smelters and refineries, their annual capacity being an output of about 360,000 tons of pig lead.

ZINC.—In order to facilitate the early establishment of Australian zinc industries, the Imperial Government has undertaken to advance £500,000 if required to finance Australian zinc works. The output of the three chief factories is about 50,000 tons of zinc concentrates.

COPPER.—Five chief companies have an output of 60,000 tons of electrolytic and fine-refined copper per annum.

Molybdenite, Wolfram and Scheelite

The Commonwealth Government in September, 1915, entered into an arrangement with the Imperial Government for the acquisition of all wolfram, molybdenite, &c., produced in Australia. Under this arrangement practically the whole of these minerals produced in Australia is being acquired for the Imperial Government, the prices fixed from January 1, 1918, being: Wolfram and scheelite, 65 per cent. WO_3 , 52s. 6d. per unit at producing centres; molybdenite, 85 per cent. MoS_2 , 100s. per unit at producing centres. This arrangement with the Imperial Government has terminated.

Electrolytic Zinc

The Electrolytic Zinc Co.'s plant at Risdon is being enlarged, and additional wharf accommodation is also being constructed. The plant is to be increased from its present capacity of 12 tons

per day until it is capable of treating about 100 tons of high grade zinc per day. It is estimated that the capital which will be eventually expended by this company in its Tasmanian operations will be in the vicinity of £1,500,000; it will thus be realised that the works are to be of considerable magnitude.

Arsenic Production

The arsenic mine situated at Jibbenbar, near Stanthorpe, has two shafts sunk, the main shaft is down to the depth of 218 ft., both shafts being connected at the 121 ft. level. The ore at the present time actually blocked out is estimated at not less than 10,000 tons, and there are 2,000 tons of ore on the dump. The lode, which is from 5 ft. to 6 ft. in width at the connecting drive, has branched out to 12 ft. at the bottom of the main shaft, and the ore has doubled in its arsenic contents. At the present time the Government are contemplating the duplication or triplication of the treatment plant; at present they are treating 600 tons per month. The Government are at present selling arsenic at £10 per ton to the holders of selections infested with prickly pear in order to provide a cheap poison to enable them to kill the pear, and at £23 per ton to the State Department of Public Lands to be supplied to makers of sheep and cattle dips for the eradication of ticks.

The Sandalwood Oil Industry

This industry has made progress in Western Australia, but its growth is said to be hindered to some extent by the fact that its product has not yet been accepted by the British Pharmacopoeia. The oil is obtained by steam distillation from the wood of the *Santalum spicatum*—a species of sandalwood indigenous to Western Australia. On being refined by a special process the oil has a bright yellow colour and has a specific gravity of 98. It possesses but a slight odour, which is not unpleasant. Its solubility in alcohol is practically one volume in six volumes of 70 per cent. ethyl alcohol. The sesquiterpene alcohol, usually referred to as santalol, is present in this oil in varying amounts, averaging about 70 per cent. Wood from certain parts of the State has been known to yield as much as 76 and 78 per cent., but this higher average is set off by the decreased amount of oil obtained from this particular wood. Sandalwood grows in Western Australia over an area more than twice as large as that of Great Britain, but the difficulties in getting it are annually increasing. Fresh enterprise is undertaking the manufacture of the oil in the hope that the British Pharmacopoeia will recognise the product, and thus throw open the markets of the world. In limited quantities sandalwood is also found in Victoria, New South Wales and Queensland, and trade with the East has been growing steadily since 1901.

A New Tanning Process

A shrub which grows principally on the goldfields of Western Australia has been found to possess properties suitable for tanning purposes. Some samples of tanning extracts from this shrub have been subjected to successful analytical tests, and leather tanned by the extracts has been adjudged equal to the best in the world; the leather tanned being specially useful in lining hats. Some excellent samples of "fast" dyes have also been extracted from the same shrub.

A company has applied lately to the Western Australian Government to make an area of country available over which the company could strip the bush to feed a tanning and extracting works, and an extensive area has been granted for the purpose.

Efforts are also being made in Western Australia to utilise another plant which grows prolifically for making rope and twine. The establishment of a woollen mill by an English company is still receiving consideration.

Hydro-Electric Development

Compared with other countries, Australia offers little prospect of hydro-electric development.

In Victoria and New South Wales various schemes are proposed.

In Tasmania the Hydro-Electric Department of the Tasmanian Government continued general extensions and survey work.

The present capacity of the plant is 18,000 H.P., and during the year 1918-19, 32,134,388 units were sold.

Canada

From the *Board of Trade Journal* of August 19 we learn that the Canadian Association of British Manufacturers and their representatives, is displaying a great deal of activity in the interests of United Kingdom trade. Their bulletin deals with important trade openings in Canada, but suggests that British manufacturers speedily make a drastic revision of their trading and credit terms. A natural preference in the matter of trading, a national bias in conjunction with Imperial sentiment, often prompts the offer of a market for British goods in Canada, but the offer does not appear to be met in kind. The intending customer is informed that the order could only be undertaken on the basis of "cash with order," or by the instituting of a "letter of credit" with a London banking house to the order of the U.K. manufacturer. No responsible Canadian house will consent to undertake business on such terms, and will not submit to dictation of them, so that the usual procedure has been the booking of the order by a foreign manufacturer on open account at sixty days' dating.

Naturally the loss of trade is important, but the absence of good feeling is even more so, and, in the words of a Canadian manufacturer, "the United Kingdom manufacturers and business houses can expect no great extension of trade in this country until they accredit to Canadian business men a measure of integrity beyond that of a band of robbers." We are not aware that the manufactures spoken of in the Bulletin above mentioned, were in any way connected with the chemical industry of the kingdom, but the facts apply, and, perhaps, chemical merchants who have or are about to have dealings with Canadian houses, will observe this, and "take the hint."

Wood Distillation

Certain plants for the destructive distillation of wood were in existence in the Dominion before 1915. The manufacture of explosives on an unprecedented scale, occasioned by the war, has given the industry a considerable impetus, on account of the large quantities of acetone required as a solvent in the production of cordite.

Crude wood alcohol is refined by fractional distillation to produce methyl alcohol and methyl acetone. Formaldehyde is a product of methyl alcohol. Acetate of lime is sometimes sold as such, but for the most part is converted into acetone or into acetic acid. The charcoal is sold either for domestic fuel or for the manufacture of charcoal iron. The by-products, gases, oils, and tar are burned under the retorts with the exception of certain oils of commercial value.

Thirteen plants, eleven of which are distillation plants, and two refineries furnish the entire production, and are, with two exceptions, controlled by the Standard Chemical Iron & Lumber Co. of Canada, Ltd. There are four distillation plants and one refinery in the Province of Quebec, and seven distillation plants and one refinery in the Province of Ontario.

Statistics show that for 1917 the total value of products from the 13 operating plants was \$5,261,176, as compared with \$2,434,716 in 1915. Crude wood-alcohol (sold as such), acetate of lime, and acetone seem to be the most valuable from the point of view of quantity produced.

The capital invested is considerable, being over \$4,000,000, of which Ontario accounted for \$2,500,000 and Quebec \$1,500,000.

Industrial Alcohol Bill

The Act provides for the sale of alcohol without the admixture of a denaturant and denatured alcohol and specially denatured alcohol, as defined in the Act, free from excise duty. Such alcohol must be manufactured, denatured or specially denatured only in premises thereto licensed. The manufacture of industrial alcohol has been stimulated considerably in the short interval elapsing between the passing of the Bill and the present conditions are prescribed whereby specially denatured alcohol shall only be sold or delivered under a special permit to dealers and manufacturers to be used in the arts and industries in cases where denatured alcohol would be unsuitable, and that it shall only be moved or transported under such conditions as the Minister approves.

What the removal of these restrictions on the production of denatured alcohol in Canada would mean may be gathered from the results of this removal on the production in the United States. Before the Act of 1906, which permits denaturing of alcohol at any distillery under conditions easily

observed, the quantity of denatured alcohol used annually did not exceed 1,500,000 proof wine gallons, but after 1907 the consumption of it increased rapidly, and reached 16,953,355 proof gallons in 1913, and 90,644,722 proof gallons in 1918, while the total amount of denatured alcohol made in Canada in 1917 was only 252,000 proof gallons. Denatured alcohol is all-important in a large number of lines of industry. This may be gathered from the enormously enhanced consumption of it in the United States since 1906, and the annual consumption in Germany of more than 200,000,000 proof Imperial gallons in the year ended August 31, 1904.

Union or Disunion?

To the Editor of THE CHEMICAL AGE

SIR,—I do not think the distinguished writer of the pungent article, "Union or Disunion?" in your number of August 7th, is entirely sincere in his wish to join a union, or, like the majority of chemists, he would have affiliated himself to one by now. Possibly he is a member of some very select society or university whose influence is far above that of any mere chemical body. Nothing is easier than criticism, and perfection in *excelsis* only comes *peu à peu*.

It may be a deplorable fact that the number of organisations claiming to interest themselves in the welfare of chemists is unnecessarily large, but most are prepared to grant that the admittedly improved position of the chemist to-day is largely due to the activities of these organisations. The author of the article under discussion has probably benefited also, but, unlike the majority of chemists, he has not given financial support to one or more of these bodies.

I should also like to remind him that there are men who join a society from altruistic reasons, to whom chemistry is something more than a *aurea sacra fames*, and who do not seek all the seductive delights he speaks of, but others of a nobler kind. Since chemistry is such a fundamental science, it seems an *a priori* necessity to have a large number of sections, each of which may call for a special protective society. We have, for example: Alchemists, biochemists, chemical engineers, chemists and druggists (the only *legal* chemists), electro chemists, metallurgists, physical chemists, research chemists, technical chemists, works chemists, and so on *ad infinitum*.

In puris naturalibus, the truth is that we want the word chemist legally defined in order to close the profession of chemistry. Is the boy who works the lift in a chemical factory a chemist? Such were some of the chemists in the Registration Act of 1916, and none could say them nay. Until the definition is obtained *Quid prodest?*. Therefore, it is every chemist's duty to support any society whose aim it is to obtain this legal definition. Afterwards no doubt the legally defined will *ad unum omnes* join one protective body and effectively close the profession to the pseudo chemists. With this end in sight there is little doubt but that the superfluous societies would see the wisdom of disbanding or, maybe, they would be able to carry on as associations of technical workers, but the word chemist would disappear from their titles.

With regard to the writer's remarks on the National Union of Scientific Workers (founded, I believe, chiefly for physicists) and its distinguished exponent, all I can say is that the matter is *de trop et n'importe* so far as the article is concerned.

ANTIMONY TARTRATE.

[We wish our correspondents would remember that this journal is printed in English, and that a few writers of quite tolerable repute find the resources of their own tongue usually sufficient for the expression of their views. The British compositor has so high an opinion of the English language that he puts a tariff, in the shape of a slightly increased charge for setting, on the use of foreign phrases or tags.—Editor, C. A.]

Recent Wills

| | |
|---|---------|
| Mr. T. A. Sutton, of Anerley, formerly a chemist in Bermondsey..... | £11,899 |
| Mr. J. Barrow, of South Woodford, Essex, a director of Edward Cook & Co., Ltd., soap manufacturers, formerly with Lever Brothers, Ltd., Port Sunlight | £13,573 |

A Study of Researches into Metallic Alloys

By C. T. Heycock, M.A., F.R.S.

The Presidential Address in the Chemical Section of the British Association, opened at Cardiff on Tuesday, took the form of a review of the researches into metallic alloys, with an appeal towards the close for fuller recognition and financial support for laboratory investigation. We give the substance of the address below.

I PROPOSE to deal to-day with the manner in which our present rather detailed knowledge of metallic alloys has been acquired, starting from the sparse information which was available 30 or 40 years ago, and to sketch very briefly the present position of our knowledge.

The production of metals and their alloys undoubtedly constitutes the oldest of those chemical arts which ultimately expanded into the modern science of chemistry, with all its overwhelming mass of experimental detail and its intricate interweaving of theoretical interpretation of the observed facts. Tubal-Cain lived during the lifetime of our common ancestor, and was "an instructor of every artificer in brass and iron"; and although it may be doubted whether the philologists have yet satisfactorily determined whether Tubal-Cain was really acquainted with the manufacture of such a complex metallic alloy as brass, it is certain that chemical science had its beginnings in the reduction of metals from their ores and in the preparation of useful alloys from those metals. In fact, metallic alloys, or mixtures of metals, have been used by mankind for the manufacture of implements of war and of agriculture, of coinage, statuary, cooking vessels and the like from the very earliest times.

In the course of past ages an immense amount of practical information has been accumulated concerning methods of reducing metals, or mixtures of metals, from their ores, and by subsequent treatment, usually by heating and cooling, of adapting the resulting metallic product to the purpose for which it was required. Until quite recent times, however, the whole of this knowledge was entirely empirical in character, because it had no foundation in general theoretical principles; it was collected in haphazard fashion in accordance with that method of trial and error which led our forerunners surely, but with excessive expenditure of time and effort, to valuable results.

To-day I purpose dealing chiefly with the non-ferrous alloys, not because any essential difference in type exists between the ferrous and non-ferrous alloys, but merely because the whole field presented by the chemistry of the metals and their alloys is too vast to be covered in any reasonable length of time.

Historical Review

The earliest recorded scientific investigations on alloys were made in 1722 by Reaumur, who employed the microscope to examine the fractured surfaces of white and grey cast iron and steel. In 1808 Widmanstatten cut sections from meteorites, which he polished and etched. The founder, however, of modern metallurgy is undoubtedly H. C. Sorby, of Sheffield. Sorby's early petrographic work on the examination of thin sections of rock under the microscope led him to a study of meteorites and of iron and steel, and in a paper read before the British Association in 1864 he describes briefly how sections "of iron and steel may be prepared for the microscope so as to exhibit their structure to a perfection that leaves little to be desired. They show various mixtures of iron, and two or three well-defined compounds of iron and carbon, graphite and slag; these constituents, being present in different proportions and arranged in various manners, give rise to a large number of varieties of iron and steel, differing by well-marked and very striking peculiarities of structure."

The methods described by Sorby for polishing and etching alloys and his method of vertical illumination (afterwards improved by Beck) are employed to-day by all who work at this branch of metallurgy. In 1887 Dr. Sorby published a paper on the microscopical structure of iron and steel in the *Journal of the Iron and Steel Institute*. This masterpiece of clear writing and expression, even with our present knowledge, needs but little emendation.

From 1854-68 Mattheisen published in the reports of the British Association and in the *Proceedings and Transactions*

of the Royal Society, a large number of papers on the electrical conductivity, tenacity and specific gravity of pure metals and alloys. He concluded that alloys are either mixtures of definite chemical compounds with an excess of one or other metal, or solutions of the definite alloy in the excess of one of the metals employed, forming, in their solid condition, what he called a solidified solution. This idea of a solidified solution has developed into a most fruitful theory, upon which much of our modern notions of alloys depends. Although at the time the experiments on the electrical conductivity did not lead to very definite conclusions, the method has since been used with great success in testing for the presence of minute quantities of impurities in the copper used for conductors.

In the *Philosophical Magazine* for 1875, F. Guthrie, in a remarkable paper, quite unconnected with alloys, gave an account of his experiments on salt solutions and attached water. He was led to undertake this work by a consideration of a paper by Dr. J. Rea, the Arctic explorer, on the comparative saltiness of freshly formed and of older ice floes. Guthrie showed that the freezing point of solutions was continuously diminished as the percentage of common salt increased, and that this lowering increased up to 23·6 per cent. of salt, when the solution solidified as a whole at about 22°C. He further showed, and this is of great importance, that the substance which first separated from solutions more dilute than 23·6 was pure ice. To the substance which froze as a whole, giving crystals of the same composition as the mother liquor, he gave the name cryohydrate. At the time he thought that the cryohydrate of salt containing 23·6 per cent. NaCl and 76·4 per cent. of water was a chemical compound, $2\text{NaCl} \cdot 21\text{H}_2\text{O}$. In succeeding years he showed that a large number of other salts gave solutions which behaved in a similar manner to common salt. He abandoned the idea that the cryohydrates were chemical compounds.

How clear his views were will be seen by quotations from his paper in the *Phil. Mag.* (5), I. and II., 1876, in which he states: (i.) When a solution weaker than the cryohydrate loses heat, ice is formed. (ii.) Ice continues to form and the temperature to fall until the cryohydrate is reached. (iii.) At the point of saturation ice and salt separate simultaneously, and the solid and liquid portions are identical in composition.

In a subsequent paper, *Phil. Mag.* (5), 17, he extends his experiments to solvents other than water, and states that the substances which separate at the lowest temperature are neither atomic nor molecular; this lowest melting-point mixture of two bodies he names the eutectic mixture. In the same paper he details the methods of obtaining various eutectic alloys of bismuth, lead, tin and cadmium.

The Work of Raoult

We have, in these papers of Guthrie's, the first important clue to what occurs on cooling a fused mixture of metals. The researches of Sorby and Guthrie, undertaken as they were for the sake of investigating natural phenomena, are a remarkable example of how purely scientific experiment can lead to most important practical results. It is not too much to claim for these investigators the honour of being the originators of all our modern ideas of metallurgy. Although much valuable information has been accumulated, no rapid advance could be made until some general theory of solution had been developed. In 1878 Raoult first began his work on the depression of the freezing-point of solvents due to the addition of dissolved substances, and he continued, at frequent intervals, to publish the results of his experiments up to the time of his death in 1901. He established for organic solvents certain general laws: (i.) That for moderate concentrations the fall of the freezing-point is proportional to the weight of the dissolved substance present in a constant weight of solvent; (ii.) that when the falls produced in the same solvent by different dis-

solved substances are compared, it is found that a molecular weight of a dissolved substance produces the same fall of the freezing-point, whatever the substance is. When, however, he applied the general laws which he had established for organic solvents to aqueous solutions of inorganic acids, bases and salts, the results obtained were hopelessly discrepant. In a paper in the *Zeit. Physikal. Chem.* for 1888 on "Osmotic Pressure in the Analogy between Solutions and Gases," Van't Hoff showed that the experiments of Pfeffer on osmotic pressure could be explained on the theory that dissolved substances were, at any rate for dilute solutions, in a condition similar to that of a gas; that they obeyed the laws of Boyle, Charles and Avogadro, and that on this assumption the depression of the freezing-point of a solvent could be calculated by means of a simple formula. He also showed that the exceptions which occurred to Raoult's laws, when applied to aqueous solutions of electrolytes, could be explained by the assumption, first made by Arrhenius, that these latter in solution are partly dissociated into their ions. The result of all this work was to establish a general theory applicable to all solutions which has been widespread in its applications. It is true that Van't Hoff's theory has been violently attacked; but it enables us to calculate the depression of the freezing-points of a large number of solvents. To do this it is necessary to know the latent heat of fusion of the pure solvent and the absolute temperature of the freezing-point of the solution. That the numbers calculated are in very close accord with the experimental values constitutes a strong argument in favour of the theory. From this time the study of alloys began to make rapid progress. Laurie (*Chem. Soc. Jour.*, 1888), by measuring the potential difference of voltaic cells composed of plates of alloy and the more negative element immersed in a solution of a salt of one of the component metals, obtained evidence of the existence of compounds such as Cu_2Zn_3 , Cu_3Sn . In 1889 F. H. Neville and I., whilst repeating Raoult's experiments on the lowering of the freezing-point of organic solvents, thought that it was possible that the well-known fact that alloys often freeze at a lower temperature than either of their constituents might be explained in a similar way. In a preliminary note communicated to the Chemical Society on March 21, 1889, on the same evening that Professor Ramsay read his paper on the molecular weights of metals as determined by the depression of the vapour pressure, we showed that the fall produced in the freezing-point of tin by dissolving metals in it was for dilute solutions directly proportional to the concentration. We also showed that the fall produced in the freezing-point of tin by the solution of one atomic weight of metal in 100 atomic weights of tin was a constant.

G. Tannman about the same time (*Zeit. Physikal. Chemie*, III., 44, 1889) arrived at a similar conclusion, using mercury as a solvent.

These experiments helped to establish the similarity between the behaviour of metallic solutions or alloys and that of aqueous and other solutions of organic compounds in organic solvents. That our experiments were correct seemed probable from the agreement between the observed depression of the freezing-point and the value calculated from Van't Hoff's formula for the case of those few metals whose latent heats of fusion had been determined with any approach to accuracy.

Our experiments, subsequently extended to other solvents, led to the conclusion that, in the case of most metals dissolved in tin, the molecular weight is identical with the atomic weight; in other words, that the metals in solution are monatomic. This conclusion, however, involves certain assumptions. Prof. Ramsay's experiments on the lowering of the vapour pressure of certain amalgams point to a similar conclusion.

Freezing at High Temperatures

So far our work had been carried out with mercury thermometers, standardised against a platinum resistance pyrometer; but it was evident that, if it was to be continued, we must have some method of extending our experiments to alloys which freeze at high temperatures. The thermo-couple was not at this stage a reliable instrument; fortunately, however, Callendar and Griffiths had brought to great perfection the electrical resistance pyrometer (*Phil. Trans.*, A, 1887 and 1891). Dr. E. H. Griffiths kindly came to our aid, and with his help we installed a complete electrical resistance set. As at this time the freezing-points of pure substances above 300 deg. were not known with any degree of accuracy, we began by making these measurements:—

Table of Freezing Points.

| | Carnelly's tables. | Holborn and Wien, 1892. | Callendar and Griffiths, 1892. | Neville and Heycock, 1895. | Burgess and Le Chatelier, 1912. High temperature measurements. |
|-----------------|--------------------|-------------------------|--------------------------------|----------------------------|--|
| Tin | ... | ... | 231.7 | 231.9 | 231.9 |
| Zinc | 433 | ... | 417.6 | 419.0 | 419.4 |
| Lead | ... | ... | 327.6 | 327.4 | 327.4 |
| Antimony | 432 | ... | 629.5 | 630.7 & | 629.2 |
| Magnesium | ... | ... | ... | *632.6 | 650 |
| Aluminium | 700 | ... | ... | †654.5 | 658 |
| Silver | 954 | 968 | 972 | 960.7 | 960.9 |
| Gold | 1,045 | 1,072 | 1,037 | 1,061.7 | 1,062.4 |
| Copper | 1,054 | 1,082 | ... | 1,080.5 | 1,083 |
| Sulphur | B.P..... | 448 | 444.53 | ... | 444.7 |

* Contaminated with silicon.

† Known to be impure.

With the exception of silver and gold, these metals were the purest obtainable in commerce.

Two facts are evident from the consideration of this table: (a) The remarkable accuracy of Callendar's formula, connecting the temperature Centigrade with the change of resistance of a pure platinum wire; (b) the accuracy of Callendar and Griffiths' determination of the boiling-point of sulphur. Although the platinum resistance pyrometer had at this time only been compared with the air thermometer up to 600°C., it will be noted that the extrapolation from 600 deg. to nearly 1,100 was justified.

I cannot leave the subject of high-temperature measurements without referring to the specially valuable work of Burgess, and also to Eza Griffiths' book on high-temperature measurements, which contains an excellent summary of the present state of our knowledge of this important subject.

Osmond and Le Chatelier

During the period that the above work on non-ferrous alloys was being done, great progress was being made in the study of iron and steel by Osmond and Le Chatelier. In 1890 the Institute of Mechanical Engineers, not apparently without considerable misgivings on the part of some of its members, formed an Alloys Research Committee. This Committee invited Professor (afterwards Sir William) Roberts-Austen to undertake research work for them. The results of his investigations are contained in a series of five valuable reports, extending from 1891 to 1899, published in the *Journal* of the Institute. The first report contained a description of an improved form of the Le Chatelier recording pyrometer, and the instrument has since proved a powerful weapon of research. In the second report, issued in 1893, the effects on the properties of copper of small quantities of arsenic, bismuth and antimony were discussed. Whilst some engineers advocated, others as strongly contended, the beneficial results of small quantities of arsenic on the copper used for the fire boxes of locomotives. The report showed that the presence of from 0.5-1 per cent. of arsenic was highly beneficial. The third report dealt with electric welding and the production of alloys of iron and aluminium. The fourth report is particularly valuable, as it contains a *résumé* of the Bakerian lecture given by Roberts-Austen on the diffusion of metals in the solid state, in which he showed that gold, even at as low a temperature as 100 deg., could penetrate into lead, and that iron became carbonised at a low red heat by contact with a diamond in a vacuum. In 1899 the fifth report appeared on the effects of the addition of carbon to iron. This report is of especial importance, because, besides a description of the thermal effects produced by carbon, which he carefully plotted and photographed, he described the microscopical appearance of the various constituents of iron. The materials of this report, together with the work of Osmond and others on steel and iron, provided much of the material on which Professor Bakhuus Roozeboom founded the iron carbon equilibrium diagram. Reference should also be made to the very valuable paper by Stansfield on the present position of the solution theory of carbonised iron (*Journ. Iron and Steel Inst.*, 11, 1900, p. 317). It may be said of this fifth report, and the two papers just referred to, that they form the most important contribution to the study of iron and steel that has ever been published. Although the

diagram for the equilibrium of iron and carbon does not represent the whole of the facts, it affords the most important clue to these alloys, and undoubtedly forms the basis of most of the modern practice of steel manufacture.

Many workers, both at home and abroad, were now actively engaged in metallurgical work—Stead, Osmond, Le Chatelier, Arnold, Hadfield, Carpenter, Ewing, Rosenhain and others too numerous to mention.

The Freezing Point Curve

In 1897 Neville and I determined the complete freezing-point curve of the copper-tin alloys, confirming and extending the work of Roberts-Austen, Stansfield and Le Chatelier; but the real meaning of the curve remained as much of a mystery as ever. Early in 1900 Sir G. Stokes suggested to us that we should make a microscopic examination of a few bronzes as an aid to the interpretation of the singularities of the freezing-point curve. An account of this work, which occupied us for more than two years, was published as the Bakerian lecture of the Royal Society in February, 1903. Whilst preparing a number of copper-tin alloys of known composition we were struck by the fact that the crystalline pattern which developed on the free surface of the slowly cooled alloys was entirely unlike the structure developed by polishing and etching sections cut from the interior; it therefore appeared probable that changes were going on within the alloys as they cooled. In the hope that, as Sorby has shown in the case of steel, we could stereotype or fix the change by sudden cooling, we melted small ingots of the copper-tin alloys and slowly cooled them to selected temperatures and then suddenly chilled them in water. The results of this treatment were communicated to the Royal Society and published in the *Proceedings*, February, 1901.

To apply this method to a selected alloy, we first determined its cooling curve by means of an automatic recorder, the curve usually showing several halts or steps in it. The temperature of the highest of these steps corresponded with a point on the liquidus—*i.e.*, when solid first separated out from the molten mass. To ascertain what occurred at the subsequent halts, ingots of the melted alloy were slowly cooled to within a few degrees above and below the halt and then chilled, with the result just seen on the screen.

The method of chilling also enabled us to fix, with some degree of accuracy, the position of points on the solidus. If an alloy, chilled when it is partly solid and partly liquid, is polished and etched, it will be seen to consist of large primary combs embedded in a matrix consisting of mother liquor, in which are disseminated numerous small combs, which we called "chilled primary." By repeating the process at successively lower and lower temperatures we obtained a point at which the chilled primary no longer formed—*i.e.*, the upper limit of the solidus.

Although we made but few determinations of the physical properties of the alloys, it is needless to say how much they vary with the temperature and with the rapidity with which they are heated or cooled.

Division of Copper-Tin Alloys

From a consideration of the singularities in the liquidus curve, coupled with the microscopic examination of slowly cooled and chilled alloys, we were able to divide the copper-tin alloys into certain groups having special qualities. It would take far too long to discuss these divisions. In interpreting our result we were greatly assisted, not only by the application of the phase rule, but also by the application of Roozeboom's theory of solid solution (unfortunately, Professor Roozeboom's letters were destroyed by fire in June, 1910), and by the advice he kindly gave us. At the time the paper was published we expressly stated that we did not regard all our results as final, as much more work was required to clear up points still obscure. Other workers—Shepherd and Blough, Giolitti and Tavanti—have somewhat modified the diagram.

Neither Shepherd and Blough nor Hoyt have published the photomicrographs upon which their results are based, so that it is impossible to criticise their conclusions. Giolitti and Tavanti have published some microphotographs, from which it seems that they had not allowed sufficient time for equilibrium to be established. In this connection I must call attention to the excellent work of Haughton on the constitution of the alloys of copper and tin (*Journ. Institute of Metals*, March, 1915). He investigated the alloys rich in tin, and

illustrated his conclusions by singularly beautiful microphotographs, and has done much to clear up doubtful points in this region of the diagram. I have dwelt at some length on this work, for copper-tin is probably the first of the binary alloys on which an attempt had been made to determine the changes which take place in passing from one pure constituent to the other. I would again call attention to the fact that, without a working theory of solution, the interpretation of the results would have been impossible.

Since 1900 many complete equilibrium diagrams have been published; amongst them may be mentioned the work of Rosenhain and Tucker on the lead-tin alloys (*Phil. Trans.*, 1908), in which they describe hitherto unsuspected changes on the lead rich side which go on when these alloys are at quite low temperatures, also the constitution of the alloys of aluminium and zinc; the work of Rosenhain and Archibutt (*Phil. Trans.*, 1911), and quite recently the excellent work of Vivian, on the alloys of tin and phosphorus, which has thrown an entirely new light on this difficult subject.

Ternary Alloys

So far I have called attention to some of the difficulties encountered in the examination of binary alloys. When we come to ternary alloys the difficulties of carrying out an investigation are enormously increased, whilst with quaternary alloys they seem almost insurmountable; in the case of steels containing always six, and usually more, constituents we can only hope to get information by purely empirical methods.

Large numbers of the elements and their compounds which originally were laboriously prepared and investigated in the laboratory, and remained dormant as chemical curiosities for many years, have in the fulness of time taken their places as important and, indeed, essential articles of commerce. Passing over the difficulties encountered by Davy in the preparation of metallic sodium and by Faraday in the production of benzene (both of which materials are manufactured in enormous quantities at the present time), I may remark that even during my own lifetime I have seen a vast number of substances transferred from the category of rare laboratory products to that which comprises materials of the utmost importance to the modern metallurgical industries. A few decades ago, aluminium, chromium, cerium, thorium, tungsten, manganese, magnesium, molybdenum, nickel, calcium and calcium carbide, corborundum, and acetylene were unknown outside the chemical laboratory of the purely scientific investigator; to-day these elements, their compounds and alloys, are amongst the most valuable of our industrial metallic products. They are essential in the manufacture of high-speed steels, of armour plate, of filaments for the electric bulb lamp, of incandescent gas mantles, and of countless other products of modern scientific industry.

All these metallic elements and compounds were discovered, and their industrial uses foreshadowed, during the course of the purely academic research work carried out in our universities and colleges; all have become the materials upon which great and lucrative industries have been built up. Although the scientific worker has certainly not exhibited any cupidity in the past—although he has been content to rejoice in his own contributions to knowledge, and to see great manufacturing enterprises founded upon his work—it is clear that the obligation devolves upon those who have reaped in the world's markets the fruit of scientific discovery to provide from their harvest the financial aid without which scientific research cannot be continued.

The truth of this statement is well understood by those of our great industrial leaders who are engaged in translating the results of scientific research into technical practice. As evidence of this, I may quote the magnificent donation of £210,000 by the British oil companies towards the endowment of the School of Chemistry in the University of Cambridge, the noble bequest of the late Dr. Messel, one of the most enlightened of our technical chemists, for defraying the cost of scientific research; the gifts of the late Dr. Ludwig Mond towards the upkeep and expansion of the Royal Institution, one of the strongholds of British chemical research; and the financial support given by the Goldsmiths' and others of the great City of London Livery Companies (initiated largely by the late Sir Frederick Abel, Sir Frederick Bramwell and Mr. George Matthey), to the foundation of the Imperial College of Science and Technology. The men who initiated these gifts

have been themselves intimately associated with developments both in science and industry; they have understood that the field must be prepared before the crop can be reaped. Fortunately, our great chemical industries are, for the most part, controlled and administered by men fully conversant with the mode in which technical progress and prosperity follow upon scientific achievement, and it is my pleasant duty to record that within the last few weeks the directors of one of our greatest chemical manufacturing concerns have, with the consent of their shareholders, devoted £100,000 to research. Doubtless other chemical industries will in due course realise what they have to gain by an adequate appreciation of pure science.

Financial Support for Chemical Industry

If the effort now being made to establish a comprehensive scheme for the resuscitation of chemical industry within our Empire is to succeed, financial support on a very liberal scale must be forthcoming from the industry itself for the advancement of purely scientific research. This question has been treated recently in so able a fashion by Lord Moulton that nothing now remains but to await the results of his appeal for funds in aid of the advancement of pure science.

In order to prevent disappointment, and a possible reaction in the future, in those who endow pure research, it is necessary to give a word of warning. It must be remembered that the history of science abounds in illustrations of discoveries regarded at the time as trivial which have in after years become epoch making.

In illustration I would cite Faraday's discovery of electromagnetic induction. He found that when a bar magnet was thrust into the core of a bobbin of insulated copper wire whose terminals were connected with a galvanometer a momentary current was produced; whilst on withdrawing the magnet a momentary reverse current occurred—a purely scientific experiment destined in later years to develop into the dynamo, and with it the whole electrical industry. Another illustration may be given: Guyton de Morveau, Northmore, Davy, Faraday and Cagniard Latour between 1800 and 1850 were engaged in liquefying many of the gases. Hydrogen, oxygen, nitrogen, marsh gas, carbon-monoxide and nitric oxide, however, resisted all efforts, until the work of Joule and Andrews gave the clue to the causes of failure. Some thirty years later, by careful application of the theoretical considerations, all the gases were liquefied. The liquefaction of oxygen and nitrogen now forms the basis of a very large and important industry.

Such cases can be multiplied indefinitely in all branches of science.

Perhaps the most pressing need of the present day lies in the cultivation of a better understanding between our great masters of productive industry, the shareholders to whom they are in the first degree responsible, and our scientific workers; if, by reason of any turbidity of vision, our large manufacturing corporations fail to discern that, in their own interest, the financial support of purely scientific research should be one of their first cares, technical advance will slacken, and other nations, adopting a more far-sighted policy, will forge ahead in science and technology. It should, I venture to think, be the bounden duty of everyone who has at heart the aims and objects of the British Association to preach the doctrine that in closer sympathy between all classes of productive labour, manual and intellectual, lies our only hope for the future.

New South African Motor Fuel

It is reported by the London Automobile Association that natalite, the new motor fuel (so called by reason of its discovery in Natal, South Africa), has been in use in that country for some time past, is well spoken of, and has had many favourable reports upon its practicability as a gasoline substitute. It is said to be a by-product of the Natal sugar industry, and is reported to be a mixture of power alcohol and ether, capable of great development, in view of the large tracts of waste vegetation available in South Africa. A British research committee is now engaged in making regulations respecting the use of this fuel, especially the necessity of denaturing the liquid to prevent its possible use as an intoxicant.

Chemical Trade Inquiries

The following inquiries, abstracted from the "Board of Trade Journal," have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1. British firms may obtain the names and addresses of the inquirers by applying to the Department (quoting the reference number and country), except where otherwise stated.

| LOCALITY OF FIRM OR AGENT. | MATERIALS. | REF. NO. |
|------------------------------------|---|----------|
| Canada (Hamilton) | Soap-makers' materials | 212 |
| Montreal ... | Glassware | 213; 223 |
| Toronto ... | Essential oils | 216 |
| Belgium (Tengres) | Fish oil and products used in the de-glycerination of oils and making of fatty acids. | 228 |
| New York ... | Glassware | 241 |
| Brazil ... | Drugs | 247 |
| Brazil ... | Chemicals; pharmaceutical products | 249; 251 |
| Spain ... | Chemicals; varnish; glass ... | 291 |
| Johannesburg. | Oils; paints; varnishes ... | 276 |
| Persia ... | Chemicals; glassware; dyes paints | 293 |
| Toronto ... | Heavy chemicals; barium chloride crystals; aluminium sulphate; sulphuric acid; beta naftol; acetate of lead | 290 |
| Serb-Croat ... (Slovene States) | Paints; varnish; oils; drugs... | 270 |
| Argentine ... | Drugs | 298 |

Benn Brothers Journals

Some Features of the Current Issues

AERONAUTICS.

"Can Airways be Made to Pay?"; "Screw Propellers," by M. A. S. Riach, F.A.S.; "Theory of Lifting Surfaces," by L. Prandtl.

THE CABINET MAKER.

(Annual Colonial Number.) "Colonial and Overseas Markets for Furniture"; "The Making of Upholstery Springs"; "The Artificial Lighting of Shop Windows."

THE ELECTRICIAN.

"Lighting and Sparking of Motor Cars by Electricity," by C. H. Stephenson; Presidential Address, by Prof. C. F. Jenkin, C.B., to Section G of the British Association; Activities of the General Post Office in the Development of Telegraph and Telephone Apparatus.

THE GAS WORLD.

"An Investigation into the Efficiency of the Domestic Coal Fire," by Dr. Margaret Fishenden; "The British Association and Fuel Economy"; "Valuation of Gasworks."

THE HARDWARE TRADE JOURNAL.

(Special Colonial Issue.) "Hints on Retail Organisation"; and "Recent Developments in Pottery."

Free Trade in Alsatian Potash

THE French Minister of Agriculture, in a notice published in the *Journee Industrielle*, reminds persons interested in the purchase of Alsatian potash salts, that trade in this commodity is now free. He adds that orders for potash are no concern of his department, and that they should be sent either to Mulhouse, or to the various representatives to the *Societe Commerciale des potasses d'Alsace*.

Whereas before the war the consumption of pure potash in France did not exceed 37,000 tons a year, the mines of Alsace were able to send to France no less than 47,000 tons of pure potash in the year 1919, and 30,000 tons in the first half of the present year. Many orders which were given some time ago have not yet been delivered, but the Minister of Agriculture has been able to arrange that a sufficient number of trains shall be placed at the disposal of the mines, to ensure the delivery of 5,000 to 8,000 tons of pure potash a month. It is, therefore, to be presumed that delays in delivery will no longer occur.

British Association Meeting at Cardiff

Special Reports of Chemical Section Proceedings

THE eighty-eighth annual meeting of the British Association opened at Cardiff on Tuesday, and continued until the end of the week. The accommodation and the arrangements for the meetings were unusually good, but the attendance was disappointing. A normal attendance numbers at least 1,500, but this year it was well under 1,000. This is accounted for by the remoteness of the city and the high cost of railway traveling. The municipal strike has interfered with traffic, and was responsible for less local attendance.

The sections began their work in the morning, when ten of the presidents delivered their addresses to audiences varying from 50 or 60 in the mathematical and educational sections to a mere handful in the economic section, and in the evening the Lord Mayor of Cardiff, Councillor G. F. Forsdike, welcomed the visitors in the Park Hall, where the retiring President, Sir Charles Parsons, introduced his successor, Dr. W. A. Herdman, F.R.S., Professor of Oceanography in Liverpool University, who comes to the chair after 16 years' service as general secretary of the Association. On the motion of Sir Charles Parsons the following message was sent to the King in Scotland, where the Association is to meet next year:—

"The members of the British Association for the Advancement of Science desire to express their loyal devotion to your Majesty, and at their meeting in the Principality of Wales hope that they may be permitted to congratulate your Majesty on the splendid work done by the Prince of Wales, which has drawn towards him the thoughts and the hearts of the whole Empire."

When the Association last met in Cardiff, 29 years ago, its president was Sir William Huggins, whose address dealt partly with the motions of the stars. This year's president carried his hearers' thoughts, not to the heights of the sky, but to the depths of the sea. He spoke both of the scientific interest and of the practical value of oceanographical inquiry, and ended with an appeal to Cardiff to establish a Welsh centre of sea-fisheries research.

Before introducing the new President, Sir Charles Parsons referred to the great loss that had fallen on British science by the death of Sir Norman Lockyer, a past President of the Association. He also spoke of the sudden death a few days ago of Professor John Perry, general treasurer since 1904, who had taken a large part in shaping the policy of the Association and in guiding successive presidents.

The Chemical Section was opened on Tuesday, when Mr. C. T. Haycock delivered his presidential address on "The Metallic Alloys," a report of which will be found on pp. 229-32.

Industrial Alcohol

At the afternoon session a paper on "Industrial Alcohol" was read by Captain A. Desborough, and was followed by an interesting discussion.

In his paper on this subject Captain Desborough said that we were approaching a stage in which the supply of petrol would not equal the demand. In consequence the price of petrol was rapidly rising and the purchase of energy in this form would in a comparatively few years be out of all proportion compared with the purchase of energy in the form of solid fuel. Therefore, the industrial problem which demanded immediate attention was the finding of a substitute available in considerable quantities, and suitable for use in these engines.

Referring to the possible sources from which alcohol may be obtained, Captain Desborough said that as far as the manufacture from calcium carbide was concerned, it was difficult to obtain definite information about costs of production. The most concrete figures available were given in a report (1918) on alcohol by the German Government. According to this report a firm at Lonza, Switzerland, contracted to supply a rectified alcohol to the Swiss Federal Government at approximately 1s. per gallon, but since then it was understood that the Lonza factory had been closed down, as the manufacture of alcohol was found to be unprofitable.

Lately it had been suggested that considerable quantities of ethyl alcohol might be produced from the ethylene present

in coke oven gases. No information was available as to the manufacturing costs of this alcohol, but in estimates from the Skinningrove Iron Co. the value of it was put at 2s. a gallon. All other methods for the manufacture of ethyl alcohol were based on the conversion of carbohydrates by fermentation. The carbohydrates might be cellulose, starch, or sugars. It was possible to get reliable information as to cost, especially in the cases of conversion from starch or sugar.

The Conversion of Cellulose to Alcohol

For the conversion of cellulose to alcohol, several processes had been worked out. According to a report of the Honorary Advisory Council for Scientific and Industrial Research of Canada, the sulphite liquor from all the pulp mills in Canada could supply 5,000,000 gallons of 95 per cent. alcohol per annum, at a cost of about 1s. 6d. a gallon. In the Simonsen and the Classes processes sawdust and waste wood are digested with sulphurous and sulphuric acids respectively at high temperatures. Part of the cellulose is thereby converted into dextrose, which may be fermented. A factory in the United States was working this process during the war.

To place alcohol on the market at, say, 3s. 2d. per gallon retail, the manufacturer would have to sell at 2s. 2d. per gallon, 1s. being absorbed by distribution and other charges. Was it possible, the lecturer asked, to manufacture 95 per cent. alcohol at 2s. 2d. per gallon and still leave a sufficient margin of profit to the manufacturer? The cost of manufacture of one gallon of 95 per cent. alcohol by fermentation in a modern factory might be put at 9d. per gallon, including depreciation on plant. If the wholesale price were 2s. 2d., there was therefore 1s. 5d. left to pay for raw materials used, and for interest on the capital invested in the factory. Leaving 4d. per gallon for this latter purpose, there was 1s. 1d. available to pay for the raw material required for the production of one gallon of 95 per cent. alcohol. As on an average 120 gallons were obtained from one ton of fermentable carbohydrates, it would be seen that the maximum price which could be offered per ton of pure carbohydrates was £6 10s. supplied at the fermentation factory.

The table below gives the corresponding prices (based on the carbohydrates present in the material) for some of the more common crops:—

| MAXIMUM PRICE PAYABLE PER TON OF— | | | | | | |
|-----------------------------------|-------------------------|------------|------------|-------------------------|--------|---------|
| Fermen-table Carbohy-drates, 100% | Jeru-salem Arti-chokes. | Pota-toes. | Man-golds. | Sugar Man-gold 13% sug. | Maize. | Rice. |
| £6 10 0 | £1 3 0 | £1 3 0 | £0 11 0 | £0 17 0 | £4 8 0 | £4 17 0 |

It was obvious that with present day prices for, say, artichokes, potatoes or mangolds, it would be impossible to attempt the manufacture of cheap alcohol.

Cost of Mass Production

Whether it was possible to bring the cost of mass production of raw materials within the figure stated above, was the crux of the whole question. The information available as to this question was in some instances exceedingly meagre. For instance, in the case of Jerusalem artichokes, estimates of yield per acre varied from 5 tons to over 30 tons per acre. If the cost of cultivation were put at £20 per acre, it would be seen that a yield of 5 tons of tubers to the acre would make it impossible to use artichokes as raw material, while at the rate of 20 tons to the acre the production of alcohol from this course could be regarded as economic. What had been said about the artichokes held good, more or less, for the others. One of them, however, deserved special mentioning. Maize was to-day offered in the open market at about £20 to £25 a ton. This price, however, was as abnormal as that of artichokes, or most other foodstuffs at the present time, but there was little doubt that in certain South American countries, such

as Peru, where two to three crops of maize might be harvested yearly, this raw material could be produced at a very much lower figure—somewhere in the neighbourhood of £2 per ton. As the maximum economic price for maize was £4. 8s., it would be seen that here at least was a raw material which, in certain localities, was eminently suited for the manufacture of cheap alcohol, and it was, Captain Desborough understood, being utilised in South Africa at the present time.

It was not suggested that the objection to using foodstuffs for the manufacture of alcohol was not valid, so far as cultivated land already in existence was concerned: there could be no such objection to the reclamation of waste land for the purpose. As to the fertility of reclaimed heath land, the lecturer quoted an instance which had come to his personal knowledge. On land of this description a small holder in the neighbourhood of Bournemouth had within the last few years reclaimed three acres of land. According to his books he averaged for five years a crop at the rate of 14 tons of artichokes per acre.

Many people appeared to think that the tropics were the most suitable place for reclaiming land for the purpose, but available figures did not entirely support this assumption with the exception, perhaps, of maize in certain climates.

The Royal Naval Cordite Factory had for some time past been engaged in the study of the production of cheap alcohol, and were working in conjunction with the department of Scientific and Industrial Research, but the experiments in hand were not sufficiently advanced to warrant any useful deductions being made. In the first place they had been, and still were, carrying out growing experiments to ascertain economies of production. Several acres of heath land had been reclaimed and had been planted with artichokes, different plots receiving different treatment. Experiments had also been carried out to ascertain the nature and economic possibilities of the cellulose contained in the artichoke stalks. They were also growing a special beet introduced by M. Vilmerin for the manufacture of alcohol in France. Further, they were now able to experiment with a tuberous plant (a *Helianthus*) which grows in the Andes at an altitude of about 6,000 feet, and which was already the subject of experiment in France. This plant, "*Pelynbia Edulis*," was said to produce tubers of from 0.5 to 2 lbs. weight, and to have a sugar content comparing favourably with that of mangolds. Finally, the possibility of dealing with cellulose on parallel lines to the Boulard process was being studied. It remained to be seen whether it would be possible to obtain an organism which would convert cellulose into fermentable sugars.

To sum up the position, Capt. Desborough said it appeared to him that, though it was perfectly certain that the total demand for power alcohol could never be met solely by home production, it was too early to say that the home manufacture was uneconomic.

Discussion

Dr. R. S. SLADE said it seemed from what the author had said, that in order to make any difference to the supplies of petrol it would be necessary to produce something like 10 million gallons of alcohol per annum in the United Kingdom. Could he say how much land would require to be cultivated for this purpose, and also in the tropics under the most favourable conditions? Personally, he felt that the problem of alcohol production would eventually be settled by the production of alcohol from coke. We had in coke, water, and air all the constituents of alcohol, and the manufacture of alcohol in this way was possible if a mechanism could be found which would do it. He believed that such a mechanism would be found.

Captain DESBOROUGH said that an output of 10 million gallons per annum was hopelessly wide of the mark of the figure which would have any effect upon the price of petrol. 300 million gallons would be nearer the mark. About 7,000 acres would produce 2 million gallons per annum.

Replying to other questions, Captain Desborough said that the alcohol used in Germany before the war was manufactured from a special beet containing about 20 per cent. carbohydrates.

A SPEAKER said that beet could be grown productively in the West of England on a large scale, but it was an economic question in that it paid to grow mangolds.

Dr. T. M. LOWRY asked as to what was being done at the Skinningrove Ironworks in the production of alcohol from ethylene.

Professor SIDGWICK referred to a Swiss method of making alcohol from wood sawdust. It was claimed that 30 gallons per ton could be obtained in this way. The position with regard to oil was so serious that every possible source of alcohol production should be taken in hand.

Dr. RILEY said that the process referred to by the last speaker consisted of dissolving sawdust in hydrochloric acid. The subject of industrial alcohol was receiving so much attention just now that he thought it would be an advantage if the British Association appointed an alcohol Committee on the lines of the Fuel Economy Committee.

Captain DESBOROUGH in reply to another speaker said that the use of brewers' grain had not, so far as he was aware, been attempted. They must remember that the brewer took a good deal of the alcohol out of the grain and also received a good price for the residue. There was a factory here where beet starch was being made, the residue from which might be useful. On the coffee estates, also, there was a pulp which contained a considerable amount of sugar, but for other reasons the coffee planters were not allowed to ferment it.

Dr. H. DESCH said that in a paper published by Mr. Bury, of the Skinningrove Iron Co., it was stated that 70 per cent. of the ethylene present in the coke oven gas was being recovered, and there was a 70 per cent. conversion of that into alcohol. The Skinningrove Works would be able to obtain over 23½ million gallons of alcohol per annum from the plant it was putting down on this basis, so that it would seem that the coke ovens of the country would be quite an appreciable source of alcohol if the process was applied to all of them. Whether that would be really a profitable matter, however, remained to be seen. The large scale plant at Skinningrove was only just beginning to be worked. There was one point, however, which should make them consider fermentation processes very seriously indeed, and that was that any process which involved the use of coal was drawing on a store of material which was exhaustible and could never be replaced, whereas if they made alcohol by a fermentation process utilising a plant product, this product could be renewed from year to year, and they would really be making the alcohol from the carbon dioxides and water of the atmosphere. Therefore, taking the long view there would seem to be serious reasons for encouraging fermentation processes utilising natural growth products rather than to draw upon our store of coal.

A SPEAKER said that until it could be shown that cellulose gave a sufficiently large amount of glucose fermentation processes would not make very much headway. He thought that that part of the problem should be closely investigated so that glucose obtainable from cellulose could be carefully ascertained. There was a great prospect for cellulose fermentation, although, perhaps, the reagents used hitherto might have been too drastic.

Professor SIDGWICK said there were two questions involved from the national and the economical point of view. There was the immediate question; it was practically certain that there would be a serious shortage of petrol, certainly within the next three or four years, and if a method could be discovered for converting the energy of coal into a form of fuel which could profitably be used in the internal combustion engine, that would be of tremendous value in the immediate future in spite of the fact that it would be using up the capital value of our coal supplies. Looking further ahead, however, it was of the greatest importance to obtain a fuel for internal combustion engines not by using up the energy of the material in the earth, but by using up plant growth. At the same time there was an immediate value in a process such as that in use at the Skinningrove Works.

The PRESIDENT said that the suggestion made by Dr. Riley that an Alcohol Committee should be formed would be brought before the Sectional Committee in due course.

THE NATALITE SPIRIT CO. OF AUSTRALIA is being formed to purchase the sole rights to manufacture and sell in Australia the South African motor spirit "Natalite," also to manufacture chloroform, ether, rectified and methylated spirits, and fertilisers.

Fuel Economy: B.A. Committee's 3rd Report

We publish below the substance of the Third Report of the Committee appointed by the British Association for the investigation of fuel economy, the utilization of coal, and smoke prevention, together with memoranda by Professor Henry Louis on "Coal Mining Statistics" and by Professor W. A. Bone on "The Skinningrove Process for the Production of Alcohol from Coke Oven Gas."

THE Committee has held altogether six meetings since its re-appointment last year, and is investigating (*inter alia*) the following matters, namely :—

(a) The present official methods of arriving at coal mining statistics (e.g., outputs of coal, &c.) in this and other coal producing countries.

(b) The effect of the war upon the British coal export trade.

(c) The chemical constitution of coal.

(d) The low temperature carbonisation of coal.

(e) The thermal efficiencies at present attainable (i) in the carbonisation and gasification of coal by various systems, (ii) in domestic fires and heating appliances, (iii) in metallurgical and other furnaces, (iv) in steam raising and power production, and (v) in regard to the generation of electric power in public stations.

(f) Sources of supply of liquid fuels.

Although the Committee has made satisfactory progress with its inquiries in certain directions during the past year, both time and opportunity have been wanting for completing them. The present Report, therefore, is of an interim nature, but the Committee hopes to report more fully on the above matters to the Edinburgh Meeting next year.

Coal Output and Average Pithead Prices

According to information furnished to the Committee by the Statistical Department of the Board of Trade, the total output of coal in the United Kingdom during the year 1919 has been provisionally estimated at 229,668,000 tons, and the total output per person employed (below and above ground) in the mines at 197·5 tons.

Owing to abnormal circumstances during the period of coal control, it is difficult to give strictly comparable figures for the average pithead prices of coal in the years immediately preceding and following (respectively) the war. According to official estimates supplied by the Statistical Department of the Board of Trade, the pithead prices per ton of coal raised in 1913, and in July 1919, respectively, were approximately as follows :—

| | Labour | Timber and Stores | Other Costs | Royalties | Owners' Profits | Compensation | Administration, &c. | Average for 1913. | On July 16, 1919. |
|-------|--------|-------------------|-------------|-----------|-----------------|--------------|---------------------|----------------------|----------------------|
| | | | | | | | | s. d. | s. d. |
| | ... | ... | ... | ... | ... | ... | ... | 6 4 | 19 5½ |
| | ... | ... | ... | ... | ... | ... | ... | 1 0 | 3 2½ |
| | ... | ... | ... | ... | ... | ... | ... | 0 11 | 1 2½ |
| | ... | ... | ... | ... | ... | ... | ... | 0 5½ | 0 6½ |
| | ... | ... | ... | ... | ... | ... | ... | 1 5 | 1 2 |
| | ... | ... | ... | ... | ... | ... | ... | — | 0 3½ |
| | ... | ... | ... | ... | ... | ... | ... | — | 0 2½ |
| Total | ... | ... | ... | ... | ... | ... | ... | 10 1½ | 26 0½ |

In the Report recently made to the Prime Minister by Messrs. Alfred Tongue & Co., Chartered Accountants, of Manchester and Glasgow, and presented to Parliament by command of His Majesty (Cmnd. 555), it was estimated that the average cost per ton of coal raised in British mines during the year ending March, 31 1920, was as follows :—

| | | | | | | | | s. d. |
|---|-----|-----|-----|-----|-----|-----|-----|-------|
| Wages... | ... | ... | ... | ... | ... | ... | ... | 19 7½ |
| Timber and Stores | ... | ... | ... | ... | ... | ... | ... | 3 10 |
| Other Costs | ... | ... | ... | ... | ... | ... | ... | 1 6 |
| Royalties | ... | ... | ... | ... | ... | ... | ... | 0 4½ |
| Administration | ... | ... | ... | ... | ... | ... | ... | 0 1 |
| Capital Adjustments under Finance Acts... | ... | ... | ... | ... | ... | ... | ... | 0 4 |
| Control and Contingencies | ... | ... | ... | ... | ... | ... | ... | 0 2 |
| Owners' Profits | ... | ... | ... | ... | ... | ... | ... | 1 2 |
| Total | ... | ... | ... | ... | ... | ... | ... | 27 3½ |

It would thus appear that the pithead cost of coal has been nearly trebled as the result of the war.

Chemistry of Coal

During the year considerable progress has been made with the researches on the chemistry of coal under the direction of Professor Bone at the Fuel Laboratories at the Imperial College of Science and Technology, further details of which will shortly be published. The Committee has also followed with close attention the work recently published (a) by Drs. Marie Stopes, R. V. Wheeler, and Rudolph Lessing upon the four macroscopically distinguishable portions of banded bituminous coal and their respective behaviour on carbonisation and oxidation, (b) by Mr. S. R. Illingworth at the Treforest School of Mines, and (c) by Mr. F. S. Sennatt and collaborators of the Lancashire and Cheshire Coal Research Association.

Future Standards of Gas Supplies

Since it reported its views on the above subject to the Bournemouth Meeting of the Association last year, the Committee has followed up the matter, and on February 2 last a deputation, consisting of the Chairman, Sir Robert Hadfield, Messrs. W. H. Patchell and H. James Yates, waited upon the then President of the Board of Trade (Sir Auckland C. Geddes, K.C.B.) to lay before him the views of the Committee upon the subject, with special reference to impending legislation.

The Gas Regulation Bill, as subsequently presented to the House of Commons on May 19 last by Sir Robert Horne (the new President of the Board of Trade), contained far-reaching new proposals concerning the public sale and distribution of gas.

During the passage of the Bill through its Committee stage in the House of Commons, the important sub-section limiting the amount of incombustible constituents permissible in gas was deleted, on the understanding that, subsequent to the passing of the Act, the matter shall be made the subject of an official inquiry by the Board of Trade. The effect of this amendment is, therefore, to put the question of "inerts" into the same category as that of carbon monoxide, and the whole matter now stands as follows :—

The Board of Trade shall, as soon as may be after the passing of this Act, cause inquiries to be held into the question whether it is necessary or desirable to prescribe any limitations of the proportion of carbon monoxide which may be supplied in gas used for domestic purposes, and into the question whether it is necessary or desirable to prescribe any limitations of the proportion of incombustible constituents which may be supplied in gas so used, and may, if on any such inquiry it appears desirable, make one or more special orders under this Act prescribing the permissible proportion in either case, and any such special order may have effect either generally or as regards particular classes of undertakings, and the provisions of the special order shall have effect as if they were enacted in this section.

When such official inquiries are instituted by the Board of Trade this Committee will hope to be given an opportunity of presenting again its views upon the matters concerned.

Alcohol from Coke Oven Gas

During the past year a notable development has been made in connection with the technology of by-product recovery from coal as the result of Mr. E. Bury's successful experimental trials, in conjunction with Mr. O. Ollander, at the Skinningrove Iron Works, upon the absorption of ethylene from debenzolised coke oven gas and its conversion into ethyl alcohol. These trials have demonstrated the possibility of obtaining on a large scale 1·6 gallons of absolute alcohol per ton of the particular Durham coal carbonised. Assuming a similar yield from the 15,000,000 tons (or thereabouts) of coal now annually carbonised in British by-product coke ovens, it is claimed to be possible to obtain from coke works alone a 95 per cent. indus-

trial alcohol in quantities equivalent to about 24 million gallons per annum of the absolute spirit.

Although a full account of the investigation has already been given by Messrs. Bury and Ollander in a paper before the Cleveland Institution of Engineers in December last, the Committee, whilst not expressing any opinion as to the commercial prospects of the process, considers that the technical importance of it is such as to warrant attention being drawn in this Report to some of its salient features.

The Committee recommends that it be re-appointed to continue its investigations with a grant of £35.

Coal Mining Statistics

By Professor Henry Louis

The most important statistics concerning coal are the figures giving the annual production of coal, the number of workers employed in the mines, the number of fatal and of non-fatal accidents respectively. These statistics are collected and published by the Government Departments in most coal-producing countries, and upon these are based a number of comparative statements by which the progress of the industry in different countries is usually estimated, such as the production per worker employed, the accident death-rate per thousand workers, &c. For most economic and social studies, the number of workers employed is in several respects the most important of these figures, and unfortunately it would appear to be the one upon which the least dependence can be placed. Elaborate reports have been drawn up, and legislation has even been enacted, based upon the comparative results of these data; and it has been quite freely assumed that the figures given for different countries or different districts of a country are properly comparable, whilst as a matter of fact the methods of arriving at these figures vary so widely that they come to bear quite different meanings, and the assumption that similar headings always connote similar interpretations is utterly without foundation.

Production

In this country the returns of the output of coal until recently included the stones and dirt sent up to bank with the coal and picked out on the belts or screens; since that time the weight of coal alone is supposed to be returned. The instructions at present issued by the Home Office read as follows:

The weight given should be the net weight after screening or sorting. . . . Where the net weight of the coal is not determined during the year in respect of which the return is being made, it will be sufficient if a deduction is made according to the average percentage of dirt extracted from the coal at the mine. In cases where the coal is sold as it leaves the pit without screening or sorting it will be proper to give the gross weight sent out of the pit as the amount of output.

It will be seen that the instructions are somewhat vague, and that they also leave considerable openings for guess-work and estimates instead of accurate facts; furthermore, the instructions would in some cases at any rate compel the inclusion of washery dirt under the heading of output, since this dirt does not always come under the heading of "dirt extracted from the coal at the mine." It is by no means uncommon for one company to control two collieries not far distant from each other and to erect at one of them a washery to which the small coal from the first colliery is to be sent for washings; in such a case if the instructions are literally followed, washery dirt will be included in the returns of the coal output from the first colliery and excluded from the second. Accordingly, it is natural that the practice in making up these returns varies greatly from district to district, and even from colliery to colliery. In some cases both the dirt picked out on the belts and that washed out in the washery are deducted from the pithead weight, i.e., from the tonnage on which the men are paid; in other cases no deduction at all is made for washery dirt, and in yet other cases an arbitrary percentage is deducted from the coal sent to the washery. There is also some difference as regards the practice concerning "free coal" given to the miners and coal for colliery consumption. In most cases all this coal is returned as part of the production; in some cases the coal consumed by the pits is not included, and apparently in a few cases both the "free

coal" and coal for colliery consumption are deducted from the output. In some places it is customary to give as a return of output the landlord's tonnage, that is the amount on which royalty is paid, which is usually the output less certain deductions allowed by the terms of the lease. In view of this wide variation it would be a distinct advantage if the Home Office were to issue specific instructions on all the above points, so as to secure uniformity of method in making returns throughout the United Kingdom. The methods used in Canada might well be adopted here.

In Canada a more definite system is adopted; the introduction to the Canadian Annual Statistics states in definite language what is intended, as follows:

The term "production" in the text and tables of this report is used to represent the tonnage of coal actually sold, or used, by the producer, as distinguished from the term "output," which is applied to the total coal extracted from the mine, and which includes, in some cases, coal lost or unsaleable or coal carried into stock on hand at the end of the year.

Apparently throughout Canada the various Provinces issue sheets which have to be filled up every month, and which the different Provincial Governments have agreed to issue in identical form, so that returns for the Dominion can be made by the Canadian Department of Mines or by the Dominion Bureau of Statistics. The whole of the collection of statistics, and, in fact, the administration of mining law, is controlled by the respective Provincial Governments, with the exception of mining lands in certain of the Western Provinces and North-West Territories, which are controlled directly by the Dominion Government. These monthly returns show the amount of free coal or of coal sold to miners at a reduced price, the quantity used for colliery consumption, specifying any used on the colliery company's own railways, the quantity of coal used for making coke and briquettes, the quantity stocked, and the quantity on hand. The only fault that can be found with these returns is that they do not specifically ask for a return of the dirt picked out and washed out respectively. In Canada the term "production" is restricted to marketable or economically useful coal, whilst the term "output" is the equivalent of what we sometimes speak of in this country as "drawings," i.e., everything drawn out from the colliery, inclusive of any dirt that may be extracted subsequently.

In the United States the production means the total production of clean coal, that is to say, coal with the exclusion of pickings and washery dirt, and including colliery consumption. The work is done by the Mineral Resources Division of the United States Geological Survey, but there is a good deal of overlapping and difficulty owing to some of the statistics being collected by State Bureaux and others by Federal Bureaux; in this respect attention may be directed to the Conference on this subject held at Washington in 1916, the results of which are printed in a report of the Committee on the Standardisation of Mining Statistics in 1918. At present cards in the shape of card slips are issued, to be filled up annually, and these ask for the total production which is defined to "include all marketable coal, excluding only refuse from washeries and slack coal wasted." It distinguishes between the coal loaded at the mine for shipment, coal used locally, colliery consumption, and coal used for making coke at the mine. It will be seen that these instructions are fairly clear and definite.

In France the production includes the whole of the drawings, deducting only the worthless waste, i.e., pickings and washery refuse.

In Belgium the same practice is followed, the production including colliery consumption and coal given or sold to employees, but definitely excluding pickings and washery waste.

It will be seen that all these producing countries are aiming at one definite meaning for the word "production," and in this respect there is at any rate uniformity of intention. Unfortunately the execution of the object leaves much to be desired. The Canadian practice of monthly returns has much in its favour; it no doubt throws a certain amount of additional work both upon individual collieries and upon the department collecting statistics, but, on the other hand, it enables half-yearly and quarterly statements to be issued very shortly after the conclusion of the respective periods, and in the same way annual statements can be produced much more rapidly.

than would be the case if the whole of the returns began to come in after the end of the year. It is quite desirable that the returns should show definitely the total weight of drawings, the weight of dirt picked and washed out, the weight given or sold to employees, the colliery consumption, and the coal used for making coke. Again, there would not be a great deal of labour involved in keeping these figures, and the information would be of the greatest value.

Number of Employees

In this country the only information asked for is a return "of persons ordinarily employed"; the returns specify that it must include all the persons employed on the mine premises, such as officials, storekeepers, clerks, &c., those employed on the pit sidings, on private branch railways and tramways, and in washeries adjacent to and belonging to the mine. Furthermore, the number employed underground must be kept separate from those employed above-ground, and there is also a separation according to age and sex. There is, however, no information as to what is meant by "the number of persons ordinarily employed," although this is evidently the crux of the whole matter. The consequence is that extremely variable methods are made use of. Some pits merely give the number of men entered on the pay sheet for the particular day in the year on which the return is made out; others take two or three days which they consider normal and average these. Some return the number of employees on the books of the company, others the number on the time roll; with the prevailing amount of absenteeism, the former number will exceed the latter by about 25 per cent., but there is no instruction as to which of the two is the figure intended to be given. Some of the more painstaking collieries average the number of men employed daily, but this is apparently exceptional. It is evident that a more definite and systematic method would have to be adopted before it is possible to attach anything like a precise meaning to returns of numbers employed in this country.

In Canada, apparently, monthly returns are made, and these are averaged for the year. The Canadian intention is to "show the actual amount of labour in terms of days worked, rather than the actual number of individual men that may have been engaged," and this is obviously the correct way of dealing with the subject. The returns ask for a classification under eight different heads and separate them into underground and above-ground workers; it may be noted that in Canada the number of men employed at the coke ovens and briquetting plants in connection with collieries is included in the mine employees, whilst according to the wording of the English return these should be excluded in this country, although there is no warranty for saying that the instructions for making the latter returns are in all cases strictly complied with. Furthermore, in Canada there is an interesting table showing the time lost through absenteeism, meaning thereby the fault of the men and through a series of other reasons which may be classified as the fault of the mine or of the industry. It would be a distinct advantage if such returns were available for this country.

In the United States of America the information asked for is the average number of men employed during the year, excluding coke workers and office force. In the exclusion of the latter item this return differs from the British return; in the exclusion of the former item it differs from the Canadian return. The number of hours per working day is also asked for, as well as the average number of days lost by strikes and the number of men thereby affected. The intention in America is to get the average number of men employed during the year, but apparently the methods of obtaining these are about as vague as they are in this country. In the report already referred to it is stated that "without instruction in regard to the way these averages (average number of employees) should be computed there will be a lack of uniformity of method, and in many cases the figures submitted will not be averages, and will not represent even approximately the real average number of persons employed." No one with any experience on the subject will doubt the accuracy of this statement, and it is certainly applicable to countries other than the United States. In the report in question the definition is put forward that "the average number of men should be the actual number of man-hours for the year." This obviously is a clear and intelligible definition, and it would probably be a great advantage if it were generally adopted.

In Belgium this principle is carried into effect: the number of employees returned represents the quotient of the number of days' work done in the year divided by the number of working days. This figure is thus really the mean number of workmen engaged during the working days.

In France, on the other hand, the number of employees is intended to be the number of names regularly on the colliery pay roll; a column is reserved for the number of days worked in the year. It is obvious that we are dealing here, under the same heading, with two entirely different conceptions; some countries return the number of men who normally get their living by the industry, without any regard to the amount of absenteeism or the length of time that these men may be at work, whilst others return the number of men who have put in a full year's work, meaning thereby have worked on all the days on which the mine was in operation. Obviously, these two figures differ widely from each other, and the fact that both are returned indifferently under the same heading vitiates many of the conclusions that have been drawn upon the basis of these returns.

Fatal Accidents.

It is a curious fact that whereas every coal mining country publishes a return of fatal accidents, there appears to be in none of them any legal definition of what constitutes a fatal accident. In the absence of legal definition in this country the Home Office has for many years made a practice of classifying all mine accidents which result in death within a year and a day as fatal accidents, apparently for no better reason than that in so doing they have followed the old Coroner's Law.

In Canada the Mineral Resources Statistics Branch does not collect accident statistics, and these appear to be left to the relative departments of different Provinces. They are not asked for in the statistical returns, but are obtained from the reports to the Inspector of Mines. In the Province of Alberta a fatal accident is construed as an accident which causes death within a twelve-month. In the other Canadian Provinces there appears to be no definition at all, and it would seem that if a man dies from the effect of a mining accident, however long the death may be after the accident, it would apparently be reported as a fatal accident for the year in which the death takes place.

In the United States mine accident statistics are gathered by the various States and are by no means as reliable as statistics gathered by the Bureau of Mines. Mr. G. S. Rice, the chief mining engineer of the Bureau of Mines at Washington, gives me the following information: "As to what constitutes a definition of a fatal accident, this varies in the different States. In some States it means immediate death, in others within a day or two, in still others, if the man dies from the direct cause of the accident before the report is turned in, which is in February for the preceding calendar year, which may mean from two to thirteen months after the accident." It will be seen that these figures are obviously vague and unreliable. It is a curious fact that in the report of the Committee on the Standardisation of Mining Statistics already referred to, the terms fatal and non-fatal accidents are freely used, but there is no attempt at definition.

In France the principle followed is that the records of fatal accidents are restricted to those who are mortally injured in a mine accident, that is to say, either those killed on the spot or who die as the result of their injuries within a few hours after the accident, or at the outside within a few months without ever having been able to resume work. With regard to those whose death, occurring after a considerably longer interval, is the consequence of injuries received, they do not appear on the record, the Statistical Department not being, as a rule, informed of their death, and being, moreover, unable to determine its real cause.

In Belgium, on the other hand, a fatal accident is restricted to an accident that causes death within 30 days.

Here, again, it may be pointed out that this extremely important matter is in a chaotic condition, and that it is most urgent that an agreement be arrived at as to what precisely is meant by a fatal accident.

Non-Fatal Accidents

Here, again, there is a wide variation to be noted in practice: In this country the return is asked for of non-fatal accidents

within any given year, non-fatal accidents being defined as accidents disabling the victim for more than seven days.

In Canada the practice varies in the different Provinces. Apparently in Nova Scotia a non-fatal accident is classified as an accident by which a man must be disabled for at least seven days, but from which he recovers. In the Province of Saskatchewan accidents entailing a disability of less than six days are not recorded. In Alberta a non-fatal accident must be reported if a man is off for more than 14 days; apparently in some cases accidents involving a disability of less than 14 days are tabulated as slight accidents.

In the United States of America the question of what constitutes a non-fatal accident is even more unsettled than the definition of a fatal accident. In some of the States statistics are collected based on the State Compensation Acts, under which compensation is paid for an injury causing a loss of at least two weeks; in metal mines apparently an accident causing a loss of at least one shift is tabulated as a slight injury, and one involving a loss of two weeks as a serious injury.

In France injuries causing disability to work for more than 20 days are counted as non-fatal accidents.

In Belgium all non-fatal accidents are accidents that cause permanent disability, whether this be total or partial, accidents involving only temporary disability not being included in the returns.

The above can only be looked upon as an attempt to supply a portion of the information which is evidently needed before it is possible to read coal mining statistics at all intelligently. It will be obvious, however, from what has been said, that attempts at comparisons, which have been so freely made without taking into account the striking differences in interpretation given above, must result in wholly inaccurate comparisons. I sincerely hope that the data here given may be further extended to all coal-producing countries, and I wish to urge again, as I have done in more than one International Congress, the importance of an International Conference for determining the precise manner in which mineral statistics of all kinds shall be collected and tabulated, and the precise meaning that should be attached to the various headings.

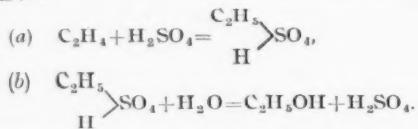
The Skinningrove Process for the Production of Alcohol from Coke Oven Gas

By Professor W. A. Bone

The following is a brief outline of the process devised by Messrs. Bury and Ollander for the removal of ethylene from debenzolised coke oven gas and its conversion into ethyl alcohol.

The average amount of olefines present in a debenzolised gas from a typical Durham coking coal is usually between 2·0 and 2·5 per cent. They consist chiefly of ethylene with small quantities of propylene and possibly other higher members of the series.

The process for their removal from the gas is based upon the well-known fact that ethylene is absorbed by concentrated sulphuric acid forming ethyl hydrogen sulphate, which may be subsequently hydrolysed by the dilution of the acid with water yielding ethyl alcohol and sulphuric acid. The sequence of the reactions concerned may be represented by the following equations:



The problem presented to the investigators was not only the determination of the conditions under which 2 per cent. of ethylene in an industrial gas can be rapidly absorbed by concentrated sulphuric acid so as to produce ethyl hydrogen sulphate exclusively, but also how the much smaller quantities of higher olefines contained in the gas can be removed from it prior to the desired absorption of ethylene.

Laboratory experiments proved (i) that, although the absorption of ethylene by concentrated sulphuric acid proceeds far too slowly at ordinary temperatures, yet between 60°C. and

80°C., the time of contact required between the acid and coke oven gas, in order to ensure the absorption of 70 per cent. of its total ethylene content, need be no more than 2½ minutes, and (ii) that under such conditions the only product formed is ethyl hydrogen sulphate. On the other hand, if the temperature be allowed to exceed 80°C. some decomposition occurs and ethyl ether is produced.

The successful operation of such an absorption process on a large scale presupposes the elimination from the crude gas of tars, ammonia, naphthalene, and benzol hydrocarbons in the order named. At the Skinningrove Works the Otto direct process is employed for this purpose.

The next step consists in the successive elimination from the cooled and debenzolised gas of (a) sulphuretted hydrogen, and (b) higher olefines than ethylene, together with most of its water vapour content. For the elimination of the sulphuretted hydrogen it is proposed to make use of the well-known reaction between sulphuretted hydrogen and sulphur dioxide gases:



The advantage of such a procedure is that it would not only dispense with the necessity of employing iron oxide purifier (except perhaps as a final precaution), but it would also enable the small amount of sulphur dioxide arising from the reduction of the hot strong sulphuric acid during the later ethylene absorption process to be utilised.

Propylene and other higher olefines are next removed by scrubbing the gas with an 80 per cent. sulphuric acid at the ordinary temperature in a tower on the counter-current principle, which also effects the removal of about 97 per cent. of its water vapour content. The resulting cooled and dried gas is then passed through a "heat exchanger" situated so near the ovens that its temperature can be raised to between 60°C. and 80°C. at the expense of some of the sensible heat in the hot crude gas leaving the ovens. The strong acid (95 per cent.) used for the absorption is also pre-heated to the same temperature. The scrubbing process for the removal of ethylene is carried out on the counter-current principle, and the time of contact between the pre-heated gas and acid is 2½ minutes, which is sufficient to effect absorption of 70 per cent. of the total ethylene present. The acid can be used until it has absorbed up to 5 per cent. of its weight of ethylene with the formation of a corresponding quantity of ethyl hydrogen sulphate.

The strong acid from the ethylene absorption towers containing the ethyl hydrogen sulphate is next taken to a special form of distilling column where it meets a current of steam which dilutes the acid to about 75 per cent. strength and simultaneously hydrolyses the ethyl hydrogen sulphate forming ethyl alcohol and sulphuric acid. The heat produced during the dilution is sufficient to raise the temperature of the diluted acid to between 90°C. and 100°C., under which conditions the resulting alcohol distils over and is subsequently condensed, finally leaving the plant as a 95 per cent. alcohol.

The diluted acid is finally pumped to the top of a Gaillard concentration tower where it is concentrated to a 95 per cent. strength, which is then used over again for the absorption of ethylene. Any small quantity of sulphurous acid formed by the reducing action of the gases upon acids in the absorption tower is, during the dilution process, decomposed, and the resulting sulphur dioxide is (as aforesaid) utilised for the elimination of sulphuretted hydrogen from the debenzolised gas.

From figures given in Messrs. Bury and Ollander's paper (*loc. cit.*) the composition of the debenzolised gas from a Durham coking coal, before and after the removal of the greater parts of its ethylene content in the manner proposed, is as follows:

| | Before | | After | |
|--------------------------------|--------|------|-------|-------|
| Carbon Dioxide... | ... | ... | 2·0 | 2·08 |
| Carbon Monoxide | ... | ... | 5·4 | 5·61 |
| Ethylene, &c. ... | ... | ... | 2·0 | 0·62 |
| Methane... | ... | ... | 25·0 | 25·96 |
| Hydrogen | ... | ... | 50·0 | 51·91 |
| Nitrogen and Water Vapour, &c. | ... | 15·6 | 13·82 | |
| | <hr/> | | 10·00 | 100·0 |
| | <hr/> | | | |
| Gross | ... | ... | 467·8 | 458·9 |
| Net | ... | ... | 412·2 | 402·8 |

From Week to Week

Charles Cullen was seriously burnt at NETHAM CHEMICAL WORKS last week through the furnace fire blowing out.

The Department of Commerce, Washington, announces that EXPLOSIVES TRADES, LTD., of London, have acquired an interest to the extent of \$25,000,000 (£5,000,000) in the General Motors Corporation.

THE KING has approved the appointment of Mr. W. C. Bridgeman, M.P., to be Secretary of Mines, and of Major Sir Philip Lloyd-Greame, M.P., to be Parliamentary Secretary to the Board of Trade.

A fire which broke out in a large shed at CHEMICALS AND BY-PRODUCTS, LTD., Rickmansworth Road, Watford, on Friday, August 20, caused damage to chemicals and plant estimated at several thousand pounds.

AT THE RESUMED INQUEST at Blackburn on Thursday, on a 12-year old girl who died, after swallowing liquid in a golf ball, the analyst's report showed that the core of the ball had contained a mixture of sodium silicate jelly.

PHINEAS KEATS, or KATZ, aged 27, a chemist, of Birmingham, who was arrested in Cornwall, appeared before the Birmingham Stipendiary Magistrate on Tuesday, and was remanded on charges of obtaining money by false pretences. Two sums were mentioned, one of £4,000 and the other £1,200.

We are informed that G. WALKER & SONS, LTD., manufacturing chemists and drug merchants, Bridgeton, Glasgow, and the CHANNEL CHEMICAL CO., chemical manufacturers, Farringdon Road, London, will exhibit at the Health and Housing Exhibition to be held at the Kelvin Hall of Industries, under the auspices of the Corporation of Glasgow, towards the middle of September.

The funeral of SIR NORMAN LOCKYER took place on Saturday, August 21, at Salcombe Regis Parish Church, Sidmouth. The chief mourners were Lady Lockyer (widow), Mr. and Mrs. Norman Lockyer, Captain and Mrs. Lockyer, and Major Lockyer. Among those who sent wreaths were the British Science Guild Executive Committee and the Hill Observatory Council and Staff.

LARGE QUANTITIES OF GLASS, it is stated, are now being offered to London dealers by firms in Czechoslovakia. The samples include building glass, lamp and ornamental glasses and optical glass. The rate of exchange is favourable to exports from Czechoslovakia, but, with the addition of freightage costs, the selling prices are brought to approximately the same level as those of British manufacturers.

A law has been passed in France which continues in force until December 31 next, the provisions of the Law of August 14, 1915, by which the CUSTOMS DUTIES in respect of paper (other than fancy paper), machine-made, weighing more than 30 grammes per square metre, for printing newspapers, and mechanical and chemical cellulose pulp destined for the manufacture of such paper, imported into France were reduced by 95 per cent.

The SOUTH AFRICAN ASSOCIATION OF ANALYTICAL CHEMISTS has appointed the following officers and council for the year ending June, 1921: President, Mr. J. Lewis; vice-president, Mr. W. B. Gray; members of council, Messrs. W. O. Andrews, John Campbell, R. B. Denison, E. H. Dodds, James Gray, C. F. Juritz, J. McCrae, J. Moir, G. H. Stanley, C. Toombs, J. A. Wilkinson; hon. treasurer, Mr. G. H. Stanley; hon. secretary, Mr. James Gray, Box 5254, Johannesburg.

The opinions expressed in the letters which have appeared in the Press recently regarding the PRESERVATION OF ANCIENT BUILDINGS by chemical treatment show very forcibly, Mr. Alan E. Munby points out, how much the problems of building demand the attention and collaboration of men of science, and that many millions might be saved annually by the expenditure of a few thousand pounds on research on this subject.

At Wednesday's anniversary meeting to promote a JAMES WATT INTERNATIONAL MEMORIAL, at Birmingham, it was stated that nearly £17,000 had been subscribed. Other sums are promised from scientific societies. The objects are the investigation of sources of power and the erection of a memorial hall, embracing a Watt Museum for engineering and scientific bodies. The Lord Mayor (Alderman Cadbury)

intimated that the Birmingham Corporation would probably be willing to follow any substantial lead for preserving Watt's residence and workshop.

A message from Vancouver states that advices brought from the far north by Mr. H. Kindersley, son of the Governor of the Hudson's Bay Company, substantiate the reports that the IMPERIAL OIL COMPANY have found oil near Fort Norman, 300 miles north-west of the Great Slave Lake. The well is down 130 ft., and is yielding 30 gallons daily of good-quality crude oil. It is expected that the district will produce oil in commercial quantities at 300 ft. The discovery is the result of many months' drilling near the border of Arctic circles.

At a meeting on Tuesday, arranged by the Royal Scottish Automobile Club and the Automobile Association, to consider the QUESTION OF MOTOR FUEL, Provost Moffat moved, and Mr. D. Maxwell seconded, that the meeting call on the Government to carry out immediately the recommendations of the Fuel Research Board on Gas Standards (providing that all gas companies be urged to extract completely the benzol from their gases), and to remove the restrictions hampering the manufacture of commercial alcohol for motor fuel. The resolution was unanimously carried.

Professor Harold B. Dixon, F.R.S., will present the results of his research work on ALCOHOL MOTOR FUEL, at a lecture in the Great Gallery of the Royal Automobile Club on Monday, October 18, at 9 p.m. Mr. Walter Long will preside, as chairman of the Motor Fuel Conference then to be in progress as part of the programme of the Imperial Motor Transport Council's sessions during the Commercial Motor Exhibition at Olympia. The Royal Automobile Club and the Commercial Motor Users' Association undertook jointly to make financial provision for research at Manchester University, under the direction of Professor Dixon, who undertook responsibility for the work at the request of the Alcohol Motor Fuel Committee appointed by Mr. Long in November, 1918.

It is officially announced from New York that A MERGER HAS BEEN COMPLETED between the International Petroleum Co., Ltd. (registered in 1914 in Canada), and the Tropical Oil Corporation (registered in 1916 in Delaware), the transaction involving approximately \$100,000,000. Under the merger it is planned to organise a new international petroleum company under the laws of Canada, with an authorised issue of at least 100,000 preferred shares with a par value of \$5, and at least 7,118,000 common shares of no par value. The Tropical Oil Corporation has outstanding approximately 1,500,000 shares, and the International Petroleum Co., Ltd., 2,500,000 common shares and 100,000 preferred shares. The new company will exchange its shares on the basis of 1,802,534 shares to the Tropical Oil Corporation for 1,575,000 shares of the Corporation.

The *Bulletin of Statistics* (No. 12), issued by the Supreme Economic Council, for June and July, points out that the QUANTITY OF COAL PRODUCED in the United Kingdom during the second quarter of 1920 was less than in the first quarter by 3,000,000 tons. In the United States there was a corresponding decrease of 17,500,000 tons; in France, including Lorraine and the Saar, the output remained steady, but no substantial increase is expected for some months; Belgium has regained its pre-war level of output. In Germany the rate of production is largely increasing, but the aggregate has not kept pace with the largely increased number of miners employed, the monthly output per man having dropped from 23½ metric tons (about 21 tons avoirdupois) in 1913 to 13½ metric tons (about 12 tons avoirdupois) in 1920 for post-war Germany as a whole.

PROPOSALS have been made for the linking-up of agricultural and chemical trade workers in Great Britain with their fellow workers abroad. The trade unions concerned have not yet had the matter brought before them, but it is stated by the General Workers' Union, whose membership includes chemical workers, that an international organisation would be strongly supported, particularly with regard to the chemical trade. Recently applications for increased wages have been met by the objection that cheap foreign competition in chemicals made it impossible to increase the cost of production at home. Mr. Ernest Bevin, of the Dockers' Union, has, it is understood, undertaken to call an international conference with the idea of forming a wide federation for the purpose of securing something like uniform conditions in all countries.

References to Current Literature

British

DRUGS. Synthetic Drugs, Cantor Lectures II. and III. (contd. from p. 635). *J. Royal Soc. Arts.* August 20. J. T. Hewitt, D.Sc. Lecture II. deals with the derivatives of the aromatic amines, and Lecture III. with the Quinoline derivatives. Especially interesting contribution.

FIBRES. Paper-making materials in the Phillipines. *J. Royal Soc. Arts.* August 20. (Editorial).

MELTING POINTS. Aggregation at melting point. W. R. Fielding. *Chem. News*, August 20, pp. 87-90.

Continued from Vol. CXX., p. 255, and deals with the last portion of the melting point curve (over 932°).

LEATHER. General commercial products from fish and marine animals (contributed). *Oil & Colour Trades J.*, August 21, p. 807.

French

NITRIC ACID. Synthetic nitric acid. M. Paul Pascal. *Bull. Soc. Chem. de France*, July 20, pp. 585-590.

OXIDES. On the priming of copper oxide and nickel oxide by oxide of iron. M. E. Toprescu. *Comptes Rend.*, August 2, pp. 393-5.

SUGAR. Crystallisable sugar and acids liberated from vegetable matter. M. H. Colin. *Comptes Rend.*, August 2, pp. 316-18.

United States

CARBON. A study of a decolorising carbon. J. C. Bock. *J. Amer. Chem. Soc.* August, pp. 1,564-9.

ANALYSIS. The liquid ammonia-sodium method for the determination of halogen in organic compounds. F. B. Dane and R. Q. Brewster. *J. Amer. Chem. Soc.* August, pp. 1,573-1,579. A paper showing that the method cannot be applied to the quantitative determination of cyanides in organic compounds.

SELENIUM. The vapour pressure curves of solid and liquid selenium near the melting point. L. E. Dodd. *J. Amer. Chem. Soc.* August, 1,579-4.

This is an interesting study of some physical qualities of selenium.

BENZENE, &c. Heats of combustion of benzene, toluene, aliphatic alcohols, cyclohexanol, and other carbon compounds. T. H. Richards and H. S. Davis. *J. Amer. Chem. Soc.*, August, pp. 1,599-1,617. An attempt to arrive at trustworthy figures for the heat of combustion of several substances.

SOLVENTS. The use of organic solvents in the quantitative separation of metals. III., the separation of magnesium from sodium and potassium chlorides. S. Palkin. *J. Amer. Chem. Soc.*, August, pp. 1,618-1,621.

ACIDS. Iodic acid—its preparation and its anhydride. A. B. Lamb, W. C. Bray, and W. J. Gelderd. *J. Amer. Chem. Soc.*, August, pp. 1,636-1,648.

ACETIC ANHYDRIDE. The action of acetic anhydride on alpha-naphthyl propionic acid. Byron L. West. *J. Amer. Chem. Soc.*, pp. 1,656.

DRUGS. Pseudo-Muscarine (synthetic muscarine). A. B. Weinhausen. *J. Amer. Chem. Soc.*, August, pp. 1,670-1,678. A study of this drug and its properties.

FRUCTOSE. The specific rotation of fructose. W. C. Vosburg. *J. Amer. Chem. Soc.*, August, pp. 1,690-1,704.

AMINES. Researches on amines, VIII. The preparation of amino-acetanilide. A. J. Hill and E. B. Kelsey. *J. Amer. Chem. Soc.*, August, pp. 1,704-11.

FATS. Fats associated with starch. T. C. Taylor and J. M. Nelson. *J. Amer. Chem. Soc.*, August, pp. 1,726-1,738.

ZINC. The electrolytic zinc plant of the Consolidated Mining and Smelting Co. of Canada, Ltd. L. W. Chapman. *Chem. and Met. Eng.*, August 11, pp. 227-231.

An interesting paper on the preparation of the solution for the electrodeposition of zinc, and construction details of tank room, cells, busbars, anodes, and cathodes.

IRON AND STEEL. Experiments on the corrosion of iron and steel. W. D. Richardson. *Chem. and Met. Eng.*, August 11, pp. 243-250.

LEATHER. Unhairing of hides and skins by enzyme action. C. S. Hollander. *J. Amer. Leather Chem. Ass.* pp. 477-87. August, 1920.

SOAP. The determination of total saponifiable matter in sulphated oils by difference. R. Hart. *J. Amer. Leather Chem. Ass.*, August, 1920, pp. 495-99.

T.N.T. products of the detonation of T.N.T. C. E. Munroe and S. P. Howell. *Proc. Amer. Phil. Soc.*, No. 3, 1920.

MORTARS. Fireclay mortars for laying fireclay brick. Raymond M. Howe. *Chem. & Met. Eng.*, August 11, pp. 232-4. An article on results of additions to fire clay and effects of shrinkage.

TALC. The uses of talc and soapstone. R. B. Ladoo. *Chem. & Met. Eng.*, August 11, pp. 235-6.

German

ANALYSIS. Qualitative analyses, sensibility, &c. *Z. anal. Chem.* O. Lutz. August, p. 145.

WATER. The cleansing of boiler-feed water. Prof. Dr. A. Kolb. *Leit. Ang. Chem.* August 10, pp. 194-5.

British Industries Fair, 1921

THE general purposes and scope of the British Industries Fairs are too well known to require recapitulation, though, to illustrate the keenness of manufacturers to secure space, we may say that within twenty-four hours of the despatch of application forms demands were being received in the Department of Overseas Trade.

The London Fair is moving for 1921 to the buildings at the White City; the Crystal Palace was not large enough to meet last year's demands for space. The provincial fairs at Glasgow and Birmingham have been marked with encouraging success last year, and bid fair to outshine their record this year.

A great advantage accruing from such an enterprise as the British Industries Fair is the vast amount of publicity which can be obtained by our Commercial Diplomatic Officers, Trade Commissioners and Consular Officers abroad. In addition to this, a scheme has been devised for a widespread Press campaign to attract the foreign buyer to the 1921 Fair. The Department of Overseas Trade has the warm support of the Birmingham and Glasgow organisations in promoting and pushing this campaign.

Taking into consideration the excellent results and good reputation established last year at all the centres of the Fair, the larger space available and the increased publicity organised for this year, it is safe to assume that the 1921 British Industries Fair will achieve a record success.

Among articles of possible interest to our readers, we have at the London Fair (February 21-March 4) leather for fancy goods, scientific and optical instruments, glass and glassware, drugs and druggists' sundries. At the Glasgow Fair (February 28-March 11) light and heavy chemicals are specially mentioned.

Imperial Chemico-technical Test Laboratory

A memorial has been presented to the German National Assembly urging the formation of an IMPERIAL CHEMICO-TECHNICAL TEST LABORATORY, which it is recommended should be formed from the Military Test Bureau which existed during the war. It is suggested that the functions of the new laboratory should include the execution of scientific and technical investigations relative to raw materials, and particularly (1) the production of materials of importance to the public—e.g. spirit from wood and acetylene instead of from potatoes, and of fatty acids from the products of coal or lignite tar or paraffin, and the utilisation and improvement, not only of cellulose as a substitute for cotton, but also of ammonium nitrate obtained synthetically in large quantities as a fertiliser; and (2) the determination of substitutes for chemical and metallurgical products not available in the country or of which there is a shortage i.e., substitutes for paraffin, camphor and glycerine, for substances used in the preservation of leather and metals, also substitutes for lubricants, rubber, gutta-percha, &c. It is also suggested that scientific and technical investigations should be carried out dealing with the prevention of accidents and the protection of workers in a number of important industries.

Patent Literature

Abstracts of Complete Specifications

125,986. DETERGENT COMPOUNDS. A. W. Foree, 6,255, St. Lawrence Avenue, Chicago, Ill., U.S.A. International Convention date (U.S.A.), April 19, 1918.

A detergent composition for removing grease from textile fabrics, consists of a mixture of soap, borax, sodium nitrate, rounded sand, Fuller's earth, ammonia and sodium chloride.

147,958. CUPROUS OXIDE, PROCESS FOR THE MANUFACTURE AND USE OF. E. C. R. Marks, London. (From Hüttenwerk Niederschönneweide Akt.-Ges. vorm. J. F. Ginsberg, Berlin-Niederschönneweide, Germany). Application date, February 1, 1918.

Copper which has been refined by blowing to about 99 per cent. of purity, is further oxidised until it has been completely converted into liquefied cuprous oxide. The oxide solidifies on cooling and may be finely ground. The oxide is more readily acted upon by acids, ammonia, and solutions of ammonia in ammonium salts, for the production of copper compounds such as copper sulphate or cuprammonia salts.

147,964. AROMATIC ALKYLAMINO COMPOUNDS, MANUFACTURE OF. F. W. Atack, Wilton Research Laboratories, 57, Dale Street, Manchester, and W. N. Haworth, University of St. Andrews, Fifeshire. Application date, January 22, 1919.

The process is for the alkylation of amino-anthraquinones. When applied to the methylation of 1-amino-anthraquinone, 20 parts of 1-amino-anthraquinone are dissolved in 216 parts of nitrobenzene and 20 parts of anhydrous sodium carbonate are added, the whole being heated to boiling under a reflux condenser. 12·5 parts of dimethyl sulphate are then gradually added and the mixture boiled, and a further 5 parts of dimethyl sulphate are then added with further boiling. The nitrobenzene is then removed by steam distillation, and the residue filtered off and washed with cold alcohol; the product may be further purified by solution in sulphuric acid and reprecipitation with water. Other examples are given of the ethylation of 1-amino-anthraquinone and the methylation of 2-amino-anthraquinone.

147,967. SULPHONATING PROCESSES AND APPARATUS FOR CARRYING OUT THE SAME. F. C. Sutton, 21, Lydford Road, Cricklewood, London. Application date, February 20, 1919.

The process is for the production of sulphonic acids from aromatic hydrocarbons and sulphuric acid. The two liquids are sprayed into the top of a steam-jacketed reaction tower from two diametrically opposed nozzles and the resulting liquid product passes downwards over a series of horizontal baffles to a collecting tank below the tower. The two liquids may be supplied to the nozzles from closed tanks by means of compressed air, and the liquid may be pre-heated if necessary. A reflux condenser may be arranged above the reaction tower.

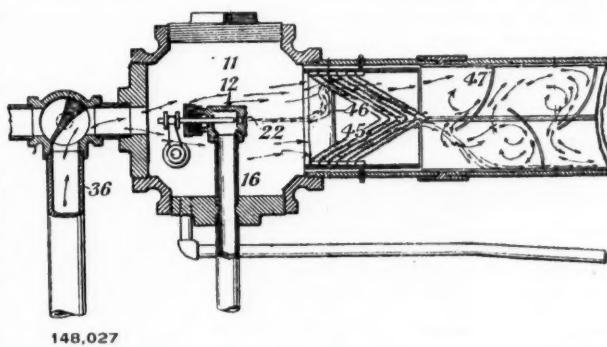
147,988. ELECTRIC FURNACES. A. M. Teixeira, 158, West 78th Street, New York. Application date, April 23, 1919.

A number of electric furnaces are combined with shaft or smelting furnace so that ore may be reduced to metal and the metal refined in the same apparatus. The bottom of the shaft communicates through radial passages with hearths of three electric furnaces which slope downwards away from the bottom of the shaft. The electrodes are arranged in each furnace at such a distance from the central shaft as to be out of contact with the slope of the charge. The hot gases generated in the electric furnaces pass upwards through the shaft furnace, accelerating the fusion and reducing the ore.

148,027. GAS, APPARATUS FOR MAKING. D. E. Campbell, 941, 12th Street, Modesto, Cal., U.S.A. Application date, May 29, 1919.

The apparatus is for converting hydrocarbon oils into gas, whereby the hydrocarbon oil is mechanically broken up to form a permanent gas without the assistance of heat. The oil is supplied at a pressure of 9 to 10 atmospheres through the pipe 16 to a jet nozzle 12, the discharge opening 22 of which has a section of about .006 sq. in. The jet is projected against

a breaker plate 46 and is thereby converted wholly or partly into a permanent gas. The nozzle is enclosed in a mixing chamber 11 into which air is passed through a pipe 36. The mixed air and gas pass onward through a series of conical screens 45, and then against inclined baffles 47, so that an

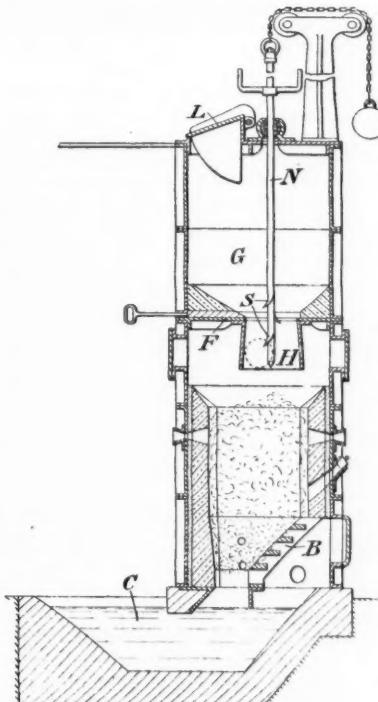


148,027

intimate mixture of air and gas is obtained. By this means a hydrocarbon oil consisting of distillate of California petroleum of 48° Bé., may be converted wholly into a stable gas without the use of heat. The gas does not condense and may be kept indefinitely. Heavier distillate of 18° Bé. may be similarly treated, but in such case only part of the oil is converted into gas by passing it once through the apparatus. The residue may be passed again through the apparatus until the whole is converted into gas.

148,057. GAS PRODUCERS. J. F. Wells, 36, Sharia Falaki, Cairo, Egypt. Application date, August 22, 1919.

The apparatus is for dealing with bulky material in a gas producer. The producer is provided with an inclined step



148,057

grate B having an ash discharge into a water seal C. A large hopper chamber G is arranged above the producer from which

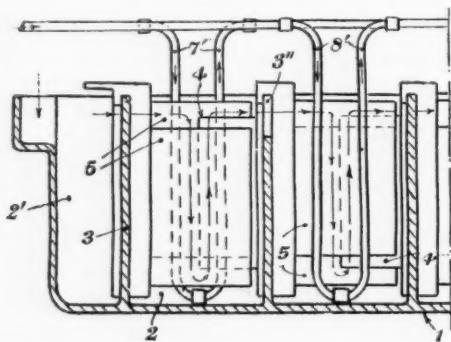
t is separated by a plate F carrying a discharge cone H. The top of the hopper is provided with a feed door L and a balanced feeding rod N having helical projections S. The hopper G contains a large amount of raw material which is gradually fed into the producer chamber J by manipulating the rod N.

148,074. COMPLEX SILVER SALTS OF ALIPHATIC α -AMINO ACIDS, MANUFACTURE OF. H. R. Napp, 7 and 8, Idol Lane, London, E.C. 3. Application date, September 23, 1919.

Complex silver salts of glycine are obtained by treating silver oxide or organic or inorganic silver salts with a solution containing an excess of glycine. The complex silver compound is precipitated by cooling the solution below 0°C . Complex silver salts of aliphatic α -amino acids may be similarly obtained. The aqueous solutions of such salts are more stable than other silver salts.

148,095. HYPOCHLORITES, ELECTROLYTIC APPARATUS FOR THE DIRECT PRODUCTION OF. P. Pestalozza, Via Canova 19, Milan, Italy. Application date, December 19, 1919.

The apparatus is for producing hypochlorites by the electrolysis of solutions of chlorides. The electrolytic vat 1 is formed by moulding a mixture of Portland cement, asbestos fibre, and water under heavy pressure, drying and impregnating with paraffin and a neutral oil at 200°C . Such a vat is unaffected by chlorine. The vat is divided into cells 2 by transverse



148 095

walls 3 having communicating openings 3'' formed at the two ends of the walls alternately. Each of the bipolar elements comprises a central anode plate 4 of platinum and two cathode side plates 5 of graphite or carbon. The plates 4, 5 are arranged on opposite sides of the cell wall and are carried by a support which slides in a slot in the wall. Cooling water is passed through two pipes which are provided with depending loops 7', 8' each, set dipping into alternate cells. A chloride solution is supplied to the chamber 2' and passes in succession through all the cells, which are in series electrically. The products of the electrolysis react to form hypochlorites the solution becoming progressively richer towards the discharge end of the vat.

Note.—Specification 138,331 (Vereinigte Chemische Werke Akt.-Ges.), which is now accepted, was abstracted when it became open to inspection under the International Convention; it relates to the production of glycerol from sugar. See THE CHEMICAL AGE, Vol. II., page 386.

International Specifications Not Yet Accepted

145,035. CUPRAMMONIUM CELLULOSE SOLUTIONS. Glanzfaden-Akt.-Ges., Petersdorf, Riesengebirge, Germany. International Convention date, October 12, 1917.

Oxidation of the cupric salt and of the cellulose is prevented by adding to the solution a sugar of the grape sugar group in the proportion of 0.25 per cent. of the cellulose. The hydration of the cellulose is effected or maintained by adding a sugar of the cane sugar group, preferably refined beet sugar. The solubility of cupric oxide in ammonia is increased by the addition of a reducing sugar, and the solution of the cellulose is rendered more rapid. The solutions of cuprammonium cellulose are permanent and may be satisfactorily spun.

145,036-7. FERTILISERS. Badische Anilin and Soda Fabrik, Ludwigshafen-on-Rhine, Germany. International Convention date, July 29, 1916.

Moist ammonium nitrate is mixed with a molecular equivalent or an excess of potassium chloride, yielding a mixture of potassium nitrate and ammonium chloride. The mixture, which is not deliquescent, may be further mixed with other fertilisers, or peat.

145,037. According to this invention which is a Patent of Addition to 145,036, the ammonium nitrate is used dry, and may be mixed with potassium chloride or sulphate.

145,038. AMMONIUM CHLORIDE. Badische Anilin and Soda Fabrik, Ludwigshafen-on-Rhine, Germany. International Convention date, March 23, 1918.

This invention is a Patent of Addition to 144,659. (See THE CHEMICAL AGE, Vol. III., page 214.) The strong ammonium chloride liquor obtained in the ammonia soda process is transferred to a vacuum apparatus while still hot, so that it is cooled by evaporation, assisted if desired by admitting a small proportion of air into the liquid to agitate it. Ammonium chloride separates out, but the evaporation is not carried beyond the point at which sodium chloride would begin to separate.

145,046. GLYCERINE. Elektro-Osmose Akt.-Ges. (Graf Schwerin Ges.), 35, Lindenstrasse, Berlin. International Convention date, April 1, 1919.

This invention is a Patent of Addition to 144,727 (See THE CHEMICAL AGE, Vol. III., page 214), which describes the bleaching of glycerine by the addition of oxalic acid. It is now found that the bleaching may be improved by adding iron powder or filings before the oxalic acid, and in some cases the use of oxalic acid may be dispensed with altogether. The iron salts formed may be precipitated by adding barium carbonate or lime.

145,053-4-5-6-7. DYES. Akt.-Ges. für Anilin-Fabrikation, Treptow, Berlin. International Convention dates, January 18, 1918, June 4, 1915, June 29, 1915, July 28, 1915, and July 31, 1915, respectively.

145,053. Diazo compounds such as 2-aminophenol-4-sulphonic acid, 4-chlor-2-aminophenol-6-sulphonic acid, or 6-nitro-2-aminophenol-4-sulphonic acid are coupled with 5 : 8-dichlor-1-oxy-naphthalene to produce monoazo dyes which are mordant wool dyes. The products give reddish blue, blue, and black shades respectively with chrome mordants.

145,054. A tetrazotised 4 : 4'-diaminoazo compound of the benzene series is coupled with one molecular part of a 1 : 8-dioxynaphthalene sulphonic acid, and then with one molecular part of a *m*-diamine of the benzene series to produce trisazo dyes, which give violet shades on cotton, becoming black on development with diazotised β -nitraniline. Alternatively these products are produced by coupling a diazotised 4'-nitro- or 4'-acidylamino-4-aminoazo compound with a 1 : 8-dioxynaphthalene sulphonic acid, reducing or saponifying, rediazotising, and coupling with a *m*-diamine. Examples are given.

145,055. A diazo sulphonic acid of the benzene or naphthalene series is coupled with a middle component, rediazotised and coupled with α -naphthylamine or its 6- or 7-sulphonic acids, diazotising again and coupling with 2 : 8 : 6-aminonaphthol sulphonic acid in alkaline solution to produce trisazo dyes which dye cotton and may be diazotised on the fibre and developed with β -naphthol or *m*-toluylenediamine giving grey shades. Examples are given.

145,056. A nitro-2-aminophenol or a sulphonic acid thereof is coupled with 2 : 5 : 7-aminonaphthol sulphonic acid in alkaline solution, rediazotised and coupled with an alkylaralkylarylamine sulphonic acid to produce secondary diazo dyes, which give black shades on wool with chrome mordants. Examples are given.

145,057. Non-sulphonated *o*-oxydiazo compounds are coupled with 1-*o*-carboxybenzoylaminoo-7-naphthol to produce monoazo dyes, which give dark green shades on wool with chrome mordants. Examples are given. To prepare 1-*o*-carboxybenzoylaminoo-7-naphthol mentioned above, 7-oxy-naphthyl-phthalimide, the condensation product from 1-amino-7-naphthol and phthalic anhydride, is treated with caustic alkali.

145,058. AMMONIA, SYNTHETIC. Badische Anilin and Soda Fabrik, Ludwigshafen-on-Rhine, Germany. International Convention date, July 2, 1915.

The process is for obtaining a gas mixture containing nitrogen and hydrogen for the synthesis of ammonia. A mixture of water gas and Dowson gas, or a mixture prepared in a water gas producer by introducing air with the steam, and consisting of nitrogen, carbon monoxide and hydrogen, is subjected to catalytic decomposition in a known manner. The resulting mixture is washed with water under a pressure of 10 atmospheres to remove carbon dioxide, and with cuprous solutions to remove carbon monoxide. The final mixture contains nitrogen and hydrogen in the required proportions.

145,059. NITROGEN OXIDES. Badische Anilin and Soda Fabrik, Ludwigshafen-on-Rhine, Germany. International Convention date, April 1, 1916.

The gas mixture resulting from the catalytic oxidation of ammonia, which is at 700°C., is cooled to about 400°C. by using it for heating a steam generator, and is then used to pre-heat the gas mixture containing ammonia and oxygen which is to be treated. Part of the preheating may be effected by radiation from the contact mass. The gas mixture is preferably heated to about 100°C. before passing it into the main pre-heater to avoid injury to the latter when constructed of iron or aluminium.

145,060. UREA. Badische Anilin and Soda Fabrik, Ludwigshafen-on-Rhine, Germany. International Convention date, August 9, 1916.

Carbon dioxide and ammonia are forced into an autoclave and kept at 135°C. for two hours. The mixture is then slowly passed into a column still, from which urea solution is obtained, and ammonia and carbon dioxide pass off to a dephlegmator and then back to the compressor. Additional ammonia and carbon dioxide may be supplied to the autoclave, or a solution of ammonium carbamate or carbonate to the top of the still.

145,071. PHthalic ANHYDRIDE. A. Wohl, 113, Hauptstrasse, Langfuhr, Danzig, Germany. International Convention date, June 28, 1916.

Naphthaline is vaporised, mixed with air, and passed over vanadium or molybdenum oxide at 380°-400°C. to produce phthalic anhydride. In one example, the catalyst may be prepared from pumice impregnated with colloidal vanadic acid solution and starch, or blood charcoal. The mixture is dried and the carbonaceous matter burnt out. Other methods of preparing the catalyst are given.

145,079. EVAPORATING OR TREATING LIQUIDS. G. A. Krause, 21, Steindorfstrasse, Munich, Germany. International Convention date, January 29, 1917. Addition to 17,508/13.

The liquid is atomised into a disc-shaped layer by a centrifugal atomiser, and the drying or reacting gas is directed downwards against the edges of the layer.

145,081. PROTOCATECHUIC ACID AND ALDEHYDE. L. Schmidt, 6, Wettenerstrasse, Leipzig, Germany. International Convention date, September 15, 1913.

Protocatechuic acid is obtained by treating piperonal with chlorine and hydrolysing the resulting chloride of dichloro-piperonylic acid by water. Protocatechuic aldehyde is obtained by treating piperonal with phosphorus pentachloride, treating the resulting piperonal chloride with chlorine to produce dichloro-piperonal chloride, and hydrolysing the latter by water. Solvents such as carbon tetrachloride, toluene, chloroform, carbon bisulphide, or petroleum ether are preferably present during the chlorination processes.

145,085. ZINC OXIDE AND AMMONIA. Metallbank und Metallurgische Ges., 45, Bockenheimer Anlage, Frankfurt-on-Main, Germany. International Convention date, February 28, 1918.

A mixture of flux skimmings and slaked lime is distilled with steam at 1.5 atmospheres pressure, ammonia being evolved. The residue is beached to dissolve the calcium chloride, and zinc oxide remains.

LATEST NOTIFICATIONS.

- 149,648. Production of sulphuric acid without chambers and towers. T. Schmiedel and H. Klencke. August 8, 1919.
- 149,662. Manufacture of sulphur dioxide by heating sulphate of alkaline earth. Verein Chemischer Fabriken Hannheim. August 8, 1919.
- 149,347. Separation of solid and liquid hydrocarbons. Deutsche Erdöl Akt.-Ges. July 31, 1919.
- 149,354. Azo dyes and their process of manufacture. R. Arnot, May 7, 1917.

Specifications Accepted, with Date of Application

- 130,968. Esters. Continuous process for the manufacture of U.S. Industrial Alcohol Co. August 7, 1918.
- 149,638. Filtering or/and mixing oils and other liquids. R. H. Cox. April 30, 1919.
- 149,055. Drying processes, and apparatus therefor. T. Boberg and Techno-Chemical Laboratories, Ltd. May 3, 1919.
- 149,085. Tunnel ovens and like structures. Dressler Tunnel Ovens, Ltd., and C. Dressler. May 14, 1919.
- 149,086. Coal and other materials capable of being distilled, vapourised, or decomposed by heat, treatment of. Dressler Tunnel Ovens, Ltd., and C. Dressler. May 14, 1919.
- 149,095. Ammonium nitrate, manufacture of. F. A. Freeth and H. E. Cockedge. May 20, 1919.
- 149,136. Mixing or beating liquids or semi-liquid substances. R. H. Morton. August 22, 1919.

Applications for Patents.

- Amsterdamsche Superfosfaatfabriek (W. N. Hirschel), Manufacture of phosphoric acid. 24,193. August 19. (Holland, June 24.)
- Bargate, A. F. Preparation of alcohol. 23,849. August 16.
- Duvivier, L. Process of preparing compounds of alumina for sizing paper, &c. 23,960. August 17. (Germany, August 18, 1919.)
- Farbwerke vorm. Meister, Lucius & Brüning. Producing fast dyes on cotton, &c. 24,303. August 20. (Germany, May 30, 1914.)
- Frink, R. L. Determining viscosity of highly-viscous material. 24,204. August 20.
- Kestner, P. Filling-material for Glover towers, &c., and means for producing same. 24,052. August 18.
- Lassen, J. J. Apparatus for delivering or measuring liquids. 24,127. August 10.
- Morris, E. F. Electrolysis of acetone solutions. 24,210. August 20.
- Nöding, M. Methods of obtaining hydrogen. 24,247, 24,249. August 20.
- " Retort furnace for generation of hydrogen. 24,248. August 20.
- Raitt, W. Isolating or extracting cellulose or paper pulp from fibrous vegetable materials. 23,864. August 16.
- Technochemia Akt.-Ges. Manufacture of artificial silk, &c. 24,277. August 20.
- Walkey, W. R. Preparation of alcohol. 23,849. August 16.

German Views on British Dye Industry

The Financial News of Wednesday contained an interesting article by a Special Correspondent in Berlin, giving the German views of the British dyestuffs industry. The Germans do not admit, it is stated, that the German dye trade has been badly hurt, and they are planning a new campaign. It is merely a question of obtaining sufficient coal and its by-products. For that purpose the Government has been approached by the joint representatives of the German dye interests. They brought powerful political influences to bear, and the Government has promised to help to the best of its ability. For some time past the German aniline dye experts have been very closely watching the developments of the new-born British dye industry organisations. They have duly reported to the dye magnates.

All the latest returns made show a sure and steady increase of production. The German firms see in the recent appeal of the Dye Users' Association to the British Government that the hopes of the consumer, in the possibility of obtaining what they need from the English Dyestuffs Corporation, are not what they had expected. The German experts describe those hopes as chimerical. On that account they report further that the time is very nigh when the German dyes will be in general demand throughout Great Britain, for Germany is able to supply more of the kind and quality of the dyes needed by the English trade than is the Dyestuffs Corporation.

Market Report and Current Prices

Our Market Report and Current Prices are exclusive to THE CHEMICAL AGE, and, being independently prepared with absolute impartiality by Messrs. R. W. Greeff & Co. and Messrs. Chas. Page & Co., Ltd., may be accepted as authoritative. The prices given apply to fair quantities delivered ex wharf or works, except where otherwise stated. The weekly report contains only commodities whose values are at the time of particular interest or of a fluctuating nature. A more complete report and list are published once a month. The current prices are given mainly as a guide to works managers, chemists, and chemical engineers; those interested in close variations in prices should study the market report.

Market Report

WEDNESDAY, August 25.

We are unable to report any improvement in the general demand for chemicals during the past week. In view of the absence of demand, the standard of values is maintained in a remarkable degree, fluctuations in prices being within very small limits.

Outside a few staple products, which are in short supply, the export demand is slow, without any particular item of interest.

General Chemicals

ACETONE.—A steady business is passing at recent values. ACID ACETIC is a quiet market, but stocks are steadily absorbed at full figures. Little weight is arriving.

ACID CARBOLIC is weaker, largely owing to export difficulties and to the absence of demand.

ACID CITRIC is unchanged. Second-hand parcels still obtainable at low rates.

ACID FORMIC is in steady inquiry and without change in price.

ACID LACTIC is uninteresting with little business passing.

ACID OXALIC is quietly steady and in moderate demand.

ARSENIC remains in short supply for early delivery. High prices are paid for spot lots.

BARIUM SALTS are without interest.

COPPER SULPHATE is still a nominal market with practically no inquiry.

FORMALDEHYDE.—There has been a certain amount of second-hand realisation of stocks, and as a result the price has been slightly weaker, although makers' prices are maintained.

LEAD SALTS are unchanged in price although the demand is very slow.

POTASSIUM BICHROMATE maintains an easier tendency and only in limited inquiry.

POTASSIUM PERMANGANATE is in quiet request—value maintained.

SODIUM ACETATE has been in rather better inquiry and exhibits a firmer tendency.

SODIUM BICHROMATE.—The supplies available remain exceedingly limited and improvement in export demand would undoubtedly tend to higher prices.

SODIUM CAUSTIC is inclined to be slightly easier as parcels of foreign make are offered at a lower rate to arrive.

SODIUM HYPOSULPHITE is unchanged and remains a nominal market.

SODIUM NITRITE is in small demand without change in value.

SODIUM SULPHIDE is inclined to be weaker owing to foreign offerings.

ZINC SALTS are featureless.

Coal Tar Intermediates

There has been still more activity in this market, although the holiday season, of course, tends to restrict business somewhat.

ANILINE OIL.—There is an active demand on export account and the price is very firm.

BETA NAPHTHOI is firmer and is extremely scarce for prompt delivery.

DIMETHYANILINE is inquired for, but there is practically nothing obtainable.

NITRO BENZOLE is inquired for, and some little business has been transacted.

NAPHTHIONIC ACID is in steady demand without change in price.

PARANITRANILINE is steady without any change to record.

XYLIDINE is more active and an advance in price may be looked for.

Coal Tar Products

There is little change to report since last week.

90's BENZOL.—This article remains scarce and is quoted at 3s. 2d. to 3s. 4d. on rails in the North and 3s. 5d. to 3s. 6d. in London.

PURE BENZOL is worth 3s. 6d. to 3s. 9d. per gallon on rails.

CREOSOTE OIL remains firm at 1s. to 1s. 1d. in the North and 1s. 1d. to 1s. 2d. in the South.

CRESYLIC ACID is still somewhat slow and is quoted at 4s. to 4s. 2d. per gallon for the Dark 95/97 per cent. quality and 4s. 6d. to 4s. 9d. per gallon for the Pale 97/99 per cent. quality.

SOLVENT NAPHTHA 90/160 is worth about 3s. 3d. per gallon on rails.

HEAVY NAPHTHA 90/190 is still worth 3s. 6d. per gallon.

NAPHTHALENE.—The demand for this article is still increasing, and the prices quoted are £16 to £20 for the Crude and £50 to £52 for the Refined.

PITCH.—The market continues firm, though not particularly active. To-day's quotations are 210s. to 220s. f.o.b. London, 195s. to 205s. f.o.b. East Coast, and 185s. to 195s. f.o.b. West Coast.

Sulphate of Ammonia

A moderate amount of export business is being done at a premium on Home Trade prices.

Current Prices

Chemicals

| | per | £ | s | d. | per | £ | s | d. |
|--------------------------------------|-----|-----|----|----|-----|-----|----|----|
| Acetic anhydride | lb. | 6 | 3 | 9 | to | 6 | 4 | 0 |
| Acetone oil | ton | 90 | 0 | 0 | to | 95 | 0 | 0 |
| Acetone, pure | ton | 120 | 0 | 0 | to | 125 | 0 | 0 |
| Acid, Acetic, glacial, 99-100%..... | ton | 115 | 0 | 0 | to | 110 | 0 | 0 |
| Acetic, 80% pure | ton | 87 | 10 | 0 | to | 90 | 0 | 0 |
| Arsenic | ton | 100 | 0 | 0 | to | 105 | 0 | 0 |
| Boric, cryst. | ton | 74 | 10 | 0 | to | 76 | 0 | 0 |
| Carbolic, cryst. 39-40% | lb. | 0 | 1 | 0 | to | 0 | 1 | 1 |
| Citric | lb. | 0 | 4 | 9 | to | 0 | 5 | 0 |
| Fluoric | lb. | 0 | 0 | 7½ | to | 0 | 0 | 8 |
| Formic, 80% | ton | 115 | 0 | 0 | to | 120 | 0 | 0 |
| Gallic, pure..... | lb. | 7 | 6 | 0 | to | 0 | 7 | 9 |
| Hydrofluoric | lb. | 0 | 0 | 7½ | to | 0 | 0 | 8 |
| Lactic, 50 vol. | ton | 58 | 0 | 0 | to | 60 | 0 | 0 |
| Lactic, 60 vol. | ton | 72 | 10 | 0 | to | 75 | 0 | 0 |
| Nitric, 80 Tw. | ton | 41 | 0 | 0 | to | 44 | 0 | 0 |
| Oxalic | lb. | 0 | 2 | 5 | to | 0 | 2 | 6 |
| Phosphoric, 1.5 | ton | 65 | 0 | 0 | to | 67 | 0 | 0 |
| Pyrogallic, cryst | lb. | 0 | 11 | 6 | to | 0 | 11 | 9 |
| Salicylic, Technical | lb. | 0 | 2 | 6 | to | 0 | 2 | 8 |
| Salicylic, B.P. | lb. | 0 | 3 | 2 | to | 0 | 3 | 3 |
| Sulphuric, 92-93%..... | ton | 8 | 10 | 0 | to | 8 | 15 | 0 |
| Tannic, commercial | lb. | 0 | 3 | 6 | to | 0 | 3 | 9 |
| Tartaric | lb. | 0 | 3 | 3 | to | 0 | 3 | 4 |
| Alum, lump..... | ton | 19 | 10 | 0 | to | 20 | 0 | 0 |
| Alum, chrome..... | ton | 92 | 0 | 0 | to | 93 | 0 | 0 |
| Alumino ferric | ton | 9 | 0 | 0 | to | 9 | 10 | 0 |
| Aluminium, sulphate, 14-15%..... | ton | 17 | 10 | 0 | to | 18 | 10 | 0 |
| Aluminium, sulphate, 17-18%..... | ton | 20 | 10 | 0 | to | 21 | 10 | 0 |
| Ammonia, anhydrous..... | lb. | 0 | 2 | 2 | to | 0 | 2 | 4 |
| Ammonia, 880..... | ton | 45 | 0 | 0 | to | 50 | 0 | 0 |
| Ammonia, 920..... | ton | 32 | 10 | 0 | to | 37 | 10 | 0 |
| Ammonia, carbonate..... | lb. | 0 | 0 | 7½ | to | — | — | — |
| Ammonia, chloride..... | ton | 100 | 0 | 0 | to | 105 | 0 | 0 |
| Ammonia, muriate (galvanisers) | ton | 60 | 0 | 0 | to | 65 | 0 | 0 |
| Ammonia, nitrate | ton | 65 | 0 | 0 | to | 70 | 0 | 0 |
| Ammonia, phosphate | ton | 125 | 0 | 0 | to | 130 | 0 | 0 |
| Ammonia, sulphocyanide | lb. | 0 | 3 | 0 | to | 0 | 3 | 3 |
| Amyl acetate | ton | 420 | 0 | 0 | to | 425 | 0 | 0 |
| Arsenic, white, powdered | ton | 74 | 0 | 0 | to | 76 | 0 | 0 |
| Barium, carbonate, 92-94%..... | ton | 12 | 10 | 0 | to | 13 | 0 | 0 |
| Barium, chloride | lb. | 0 | 0 | 11 | to | 0 | 1 | 0 |
| Chloride | ton | 32 | 0 | 0 | to | 33 | 0 | 0 |
| Nitrate | ton | 55 | 0 | 0 | to | 56 | 0 | 0 |

| | per | £ | s. | d. | per | £ | s. | d. |
|--|-------|----------|----|----|-----|-----|----|-----|
| Barium Sulphate, blanc fixe, dry... | ton | 28 | 10 | 0 | to | 30 | 0 | 0 |
| Sulphate, blanc fixe, pulp ... | ton | 16 | 10 | 0 | to | 17 | 0 | 0 |
| Sulphocyanide, 95% | lb. | 0 | 1 | 6 | to | 0 | 1 | 8 |
| Bleaching powder, 35-37% | ton | 26 | 0 | 0 | to | 28 | 0 | 0 |
| Borax crystals | ton | 41 | 0 | 0 | to | 42 | 10 | 0 |
| Calcium acetate, Brown..... | ton | 20 | 0 | 0 | to | 21 | 0 | 0 |
| " Grey..... | ton | 35 | 0 | 0 | to | 37 | 10 | 0 |
| Calcium Carbide | ton | 30 | 0 | 0 | to | 32 | 0 | 0 |
| Chloride..... | ton | 9 | 10 | 0 | to | 10 | 10 | 0 |
| Carbon bisulphide..... | ton | 65 | 0 | 0 | to | 67 | 0 | 0 |
| Casein, technical | ton | 75 | 0 | 0 | to | 80 | 0 | 0 |
| Cerium oxalate..... | lb. | 0 | 3 | 9 | to | 0 | 4 | 0 |
| Chromium acetate | lb. | 0 | 1 | 2 | to | 0 | 1 | 4 |
| Cobalt acetate | lb. | 0 | 8 | 6 | to | 0 | 9 | 0 |
| Oxide, black | lb. | 0 | 10 | 0 | to | 0 | 10 | 3 |
| Copper chloride | lb. | 0 | 1 | 3 | to | 0 | 1 | 6 |
| Sulphate | ton | 41 | 0 | 0 | to | 42 | 0 | 0 |
| Cream Tartar, 98-100%..... | ton | 275 | 0 | 0 | to | 280 | 0 | 0 |
| Epsom salts (<i>see</i> Magnesium sulphate) | | | | | | | | |
| Formaldehyde 40% vol..... | ton | 325 | 0 | 0 | to | 330 | 0 | 0 |
| Formosul (Rongalite) | lb. | 0 | 5 | 0 | to | 0 | 5 | 6 |
| Glauber salts | ton | Nominal. | | | | | | |
| Glycerine, crude..... | ton | 70 | 0 | 0 | to | 72 | 10 | 0 |
| Hydrogen peroxide, 12 vols. | gal. | 0 | 2 | 8 | to | 0 | 2 | 9 |
| Iron perchloride | ton | 50 | 0 | 0 | to | 52 | 0 | 0 |
| Iron sulphate (Copperas) | ton | 4 | 0 | 0 | to | 4 | 5 | 0 |
| Lead acetate, white | ton | 85 | 0 | 0 | to | 87 | 10 | 0 |
| Carbone (White Lead)..... | ton | 65 | 0 | 0 | to | 67 | 10 | 0 |
| Nitrate..... | ton | 55 | 0 | 0 | to | 57 | 0 | 0 |
| Litharge | ton | 59 | 0 | 0 | to | 61 | 0 | 0 |
| Lithopone, 30% | ton | 50 | 0 | 0 | to | 51 | 0 | 0 |
| Magnesium chloride..... | ton | 15 | 10 | 0 | to | 16 | 10 | 0 |
| Carbonate, light..... | cwt | 2 | 15 | 0 | to | 3 | 0 | 0 |
| Sulphate (Epsom salts commercial) | ton | 13 | 10 | 0 | to | 14 | 0 | 0 |
| Sulphate (Druggists') | ton | 18 | 10 | 0 | to | 19 | 10 | 0 |
| Manganese, Borate..... | ton | 190 | 0 | 0 | to | — | | |
| Sulphate | ton | 100 | 0 | 0 | to | 105 | 0 | 0 |
| Methyl acetone | ton | 95 | 0 | 0 | to | 100 | 0 | 0 |
| Alcohol, 1% acetone | gall. | Nominal. | | | | | | |
| Nickel sulphate, single salt | ton | 60 | 0 | 0 | to | 62 | 0 | 0 |
| Nickel ammonium sulphate, double salt..... | ton | 62 | 0 | 0 | to | 64 | 0 | 0 |
| Potassium bichromate | lb. | 0 | 2 | 1 | to | 0 | 2 | 2 |
| Potassium Carbonate, 90% | ton | 115 | 0 | 0 | to | 120 | 0 | 0 |
| Chloride..... | ton | 50 | 0 | 0 | to | 52 | 0 | 0 |
| Chlorate | lb. | 0 | 0 | 9½ | to | 0 | 0 | 10½ |
| Meta-bisulphite, 50-52% | ton | 260 | 0 | 0 | to | 270 | 0 | 0 |
| Nitrate, refined | ton | 65 | 0 | 0 | to | 67 | 0 | 0 |
| Permanganate | lb. | 0 | 4 | 0 | to | 0 | 4 | 3 |
| Prussiate, red | lb. | 0 | 4 | 9 | to | 0 | 5 | 0 |
| Prussiate, yellow | lb. | 0 | 2 | 0 | to | 0 | 2 | 1 |
| Sulphate, 90% | ton | 31 | 0 | 0 | to | 33 | 0 | 0 |
| Sal ammoniac, firsts | cwt. | 5 | 10 | 0 | to | — | | |
| Seconds | cwt. | 5 | 5 | 0 | to | — | | |
| Sodium acetate | ton | 59 | 0 | 0 | to | 61 | 0 | 0 |
| Arsenate, 45% | ton | 60 | 0 | 0 | to | 62 | 0 | 0 |
| Bicarbonate | ton | 10 | 10 | 0 | to | 11 | 0 | 0 |
| Bichromate | lb. | 0 | 1 | 7 | to | 0 | 1 | 8 |
| Bisulphite, 60-62% | ton | 50 | 0 | 0 | to | 52 | 10 | 0 |
| Chlorate | lb. | 0 | 0 | 5½ | to | — | | |
| Caustic, 70% | ton | 36 | 10 | 0 | to | 38 | 0 | 0 |
| Caustic, 76% | ton | 39 | 10 | 0 | to | 41 | 0 | 0 |
| Hydrosulphite, powder, 85% | lb. | 0 | 4 | 0 | to | 0 | 4 | 6 |
| Hyposulphite, commercial | ton | 35 | 10 | 0 | to | 37 | 10 | 0 |
| Nitrite, 96-98% | ton | 87 | 10 | 0 | to | 90 | 0 | 0 |
| Phosphate, crystal | ton | 44 | 0 | 0 | to | 46 | 0 | 0 |
| Perborate | lb. | 0 | 2 | 2 | to | 0 | 2 | 4 |
| Prussiate | lb. | 0 | 1 | 2½ | to | 0 | 1 | 3½ |
| Sulphide, crystals | ton | 30 | 0 | 0 | to | 32 | 0 | 0 |
| Sulphide, solid, 60-62% | ton | 62 | 10 | 0 | to | 64 | 0 | 0 |
| Sulphite, cryst..... | ton | 15 | 10 | 0 | to | 16 | 10 | 0 |
| Strontium carbonate | ton | 85 | 0 | 0 | to | 90 | 0 | 0 |
| Nitrate | ton | 90 | 0 | 0 | to | 95 | 0 | 0 |
| Sulphate, white | ton | 8 | 10 | 0 | to | 10 | 0 | 0 |
| Sulphur chloride..... | ton | 42 | 0 | 0 | to | 44 | 10 | 0 |
| Sulphur, Flowers | ton | 19 | 0 | 0 | to | 19 | 10 | 0 |
| Roll | ton | 19 | 0 | 0 | to | 19 | 10 | 0 |
| Tartar emetic | lb. | 0 | 3 | 2 | to | 0 | 3 | 4 |
| Tin perchloride, 33% | lb. | 0 | 2 | 6 | to | 0 | 2 | 7 |
| Perchloride, solid | lb. | 0 | 3 | 0 | to | 0 | 3 | 3 |
| Protocloride (tin crystals).... | lb. | 0 | 2 | 0 | to | 0 | 2 | 1 |
| Zinc chloride, 102 T.w. | ton | 22 | 0 | 0 | to | 23 | 10 | 0 |
| Chloride, solid, 96-98% | ton | 60 | 0 | 0 | to | 65 | 0 | 0 |
| Oxide, 99% | ton | 82 | 10 | 0 | to | 85 | 0 | 0 |
| Oxide, 94-95% | ton | 70 | 0 | 0 | to | 72 | 10 | 0 |
| Dust, 90% | ton | 90 | 0 | 0 | to | 92 | 10 | 0 |
| Sulphate | ton | 21 | 10 | 0 | to | 23 | 10 | 0 |

| | per | £ | s. | d. | per | £ | s. | d. |
|---------------------------------------|-----|---|----|----|-----|---|----|----|
| Alphanaphthol, crude | lb. | 0 | 4 | 0 | to | 0 | 4 | 3 |
| Alphanaphthol, refined | lb. | 0 | 5 | 6 | to | 0 | 5 | 9 |
| Alphanaphthylamine | lb. | 0 | 4 | 0 | to | 0 | 4 | 3 |
| Aniline oil, drums extra | lb. | 0 | 1 | 8 | to | 0 | 1 | 9 |
| Aniline salts | lb. | 0 | 1 | 10 | to | 0 | 2 | 0 |
| Anthracene, 85-90% | lb. | — | | | to | — | | |
| Benzaldehyde (free of chlorine) | lb. | 0 | 5 | 9 | to | 0 | 6 | 0 |
| Benzidine, base | lb. | 0 | 13 | 6 | to | 0 | 14 | 0 |
| Benzidine, sulphate | lb. | 0 | 10 | 6 | to | 0 | 11 | 0 |
| Benzoic acid | lb. | 0 | 5 | 3 | to | 0 | 5 | 6 |
| Benzoate of soda | lb. | 0 | 5 | 3 | to | 0 | 5 | 6 |
| Benzyl chloride, technical | lb. | 0 | 2 | 0 | to | 0 | 2 | 3 |
| Betanaphthol benzoate | lb. | 1 | 6 | 0 | to | 1 | 7 | 6 |
| Betanaphthol | lb. | 0 | 5 | 6 | to | 0 | 5 | 9 |
| Betanaphthylamine, technical | lb. | 0 | 11 | 6 | to | 0 | 12 | 6 |
| Crocein Acid, 100% basis | lb. | 0 | 5 | 0 | to | 0 | 6 | 3 |
| Dichlorbenzol | lb. | 0 | 0 | 6 | to | 0 | 0 | 7 |
| Diethylaniline | lb. | 0 | 7 | 9 | to | 0 | 8 | 6 |
| Dinitrobenzol | lb. | 0 | 1 | 4 | to | 0 | 1 | 5 |
| Dinitrochlorbenzol | lb. | 0 | 1 | 5 | to | 0 | 1 | 6 |
| Dinitronaphthaline | lb. | 0 | 1 | 6 | to | 0 | 1 | 8 |
| Dinitrotoluol | lb. | 0 | 1 | 8 | to | 0 | 1 | 9 |
| Dinitrophenol | lb. | 0 | 2 | 9 | to | 0 | 3 | 0 |
| Dimethylaniline | lb. | 0 | 5 | 3 | to | 0 | 5 | 9 |
| Diphenylamine | lb. | 0 | 5 | 0 | to | 0 | 5 | 3 |
| H-Acid | lb. | 0 | 14 | 6 | to | 0 | 15 | 0 |
| Metaphenylenediamine | lb. | 0 | 5 | 9 | to | 0 | 6 | 0 |
| Monochlorbenzol | lb. | 0 | 0 | 10 | to | 0 | 1 | 0 |
| Metanilic Acid | lb. | 0 | 7 | 6 | to | 0 | 8 | 6 |
| Monosulphonic Acid (2:7) | lb. | 0 | 7 | 6 | to | 0 | 8 | 0 |
| Naphthionic acid, crude | lb. | 0 | 5 | 6 | to | 0 | 6 | 0 |
| Naphthionate of Soda | lb. | 0 | 6 | 0 | to | 0 | 6 | 3 |
| Naphthylamin-di-sulphonic-acid | lb. | 0 | 5 | 6 | to | 0 | 6 | 6 |
| Nitromonaphthaline | lb. | 0 | 1 | 4 | to | 0 | 1 | 6 |
| Nitrotoluol | lb. | 0 | 1 | 3 | to | 0 | 1 | 4 |
| Orthoamidophenol, base | lb. | 0 | 18 | 0 | to | 1 | 0 | 0 |
| Orthodichlorbenzol | lb. | 0 | 1 | 1 | to | 0 | 1 | 2 |
| Orthotoluidine | lb. | 0 | 2 | 6 | to | 0 | 2 | 9 |
| Orthonitrotoluol | lb. | 0 | 1 | 3 | to | 0 | 1 | 4 |
| Para-amidophenol, base | lb. | 0 | 15 | 0 | to | 0 | 16 | 0 |
| Para-amidophenol, hydrochlor | lb. | 0 | 15 | 6 | to | 0 | 16 | 6 |
| Paradichlorbenzol | lb. | 0 | 0 | 6 | to | 0 | 0 | 8 |
| Paranitraniline | lb. | 0 | 8 | 6 | to | 0 | 9 | 0 |
| Paranitrotoluol | lb. | 0 | 2 | 9 | to | 0 | 3 | 0 |
| Paraphenylenediamine, distilled | lb. | 0 | 13 | 6 | to | 0 | 14 | 6 |
| Paratoluidine | lb. | 0 | 8 | 6 | to | 0 | 9 | 6 |
| Phthalic anhydride | lb. | 0 | 4 | 9 | to | 0 | 5 | 0 |
| R. Salt, 100% basis | lb. | 0 | 4 | 0 | to | 0 | 4 | 2 |
| Resorcin, technical | lb. | 0 | 11 | 6 | to | 0 | 12 | 6 |
| Resorcin, pure | lb. | 1 | 2 | 6 | to | 1 | 5 | 0 |
| Salol | lb. | 0 | 6 | 9 | to | 0 | 7 | 0 |
| Shaeffer acid, 100% basis | lb. | 0 | 3 | 6 | to | 0 | 3 | 0 |
| Sulphanilic acid, crude | lb. | 0 | 1 | 6 | to | 0 | 1 | 7 |
| Tolidine, base | lb. | 0 | 10 | 6 | to | 0 | 11 | 6 |
| Tolidine, mixture | lb. | 0 | 3 | 0 | to | 0 | 3 | 6 |

Manchester Chemical Trade

SIR S. W. ROYSE & CO., LTD., in their monthly circular state: Notwithstanding the holiday season, a fair business has been put through during August both for home and export. There has recently been a considerable movement of goods, due no doubt to a certain extent to the further increases in rates of carriage coming into force at the beginning of next month. There has been little business passing in sulphate of copper, but prices have remained steady, with the better feeling as regards the metal. Green copperas continues in good demand, although there is some accumulation of stocks owing to transport difficulties. Acetates of lime have been little called for, and supplies of acetic acid are in excess of present requirements. There has been a fair inquiry for acetate of soda, but acetates of lead are easier with the arrival of Continental parcels. Nitrate of lead is unchanged. Carbonate of potash is in moderate demand, and prices are a shade easier. Sulphate of potash continues scarce. White powdered arsenic has had a ready sale, especially the Cornish brands, and producers are sold well ahead. There have been some quantities of foreign supplies coming in, but they have been quickly cleared, and stocks all round are small. The lower prices for yellow prussiates of potash and soda have not stimulated inquiry, and there is keen competition for business. The home demand for tartaric acid continues disappointing, but some good export trade at lower prices is reported. There is no change in

ream of tartar; second-hand parcels are still freely offered but makers hold firmly to their prices. Citric acid is again lower, but demand is only small. Supplies of bichromates of potash and soda are more plentiful, and lower prices are accepted by holders of stocks of American products. Oxalic acid has been freely coming in from the Continent, and price is lower. The heavy demand continues for borax and boracic acid. The position of phosphate of soda is easier with the arrivals of supplies from abroad. Lump sal ammoniac is slow, but makers of muriate of ammonia are well supplied with orders, through the continued strong export demand. There is a better inquiry for bleaching powder. Caustic soda and ammonia alkali remain in fair request. Tar products continue in good demand. The scarcity of supplies of benzol is more pronounced and prices are firmer. Solvent naphtha is in little demand for spot delivery, owing to slackness in the rubber trade, but the tendency is towards higher values. Creosote oil remains steady. There are only limited supplies of crude carbolic acid offering and the position is unchanged. Little business is being done in crystal carbolic, but liquid carbolic is still in good request for export account. The price of pitch continues to advance with increasing demand for home and export, and consumers are showing anxiety to cover their forward requirements. Naphthalenes remain firm with little offering. Sulphate of ammonia continues without change so far as the home market is concerned, whilst the export demand shows a slight falling off. Prices, however, remain steady.

Alsatian Potash

POTASH supplied from Alsace during the past week has been quoted at the following rates F.O.R. in bags: Sylvinit, 14 per cent. French kainit, £7. 13s. 6d.; Sylvomite, 20 per cent. French potash manure salts, £9. 13s. 6d.; Sylvinit, 30 per cent., £13. 13s. 6d.; Muriate of potash, 50 per cent., £28. 5s.

Japanese Chemical Market

THE Japanese chemical market is particularly bad at present. It is stated that there has been a heavy over-stocking and in dyestuffs, chemicals and fertilisers a heavy fall in all Japanese markets. Japanese dye makers, who for the most part were making the easiest colours to manufacture, such as sulphur dyes, have either suspended or curtailed their productions, and dye importers have cabled to manufacturers abroad cancelling contracts. Almost all possible measures have been adopted to stop further cargoes. For some time to come the importation of colours will practically cease. Dealers have attempted to sell the floating stock in China and other Eastern countries, but this measure has failed apparently. Prices in China have dropped lower than in Japan. As an emergency measure, the dealers in Osaka are trying to organise a syndicate of colour and dye merchants. In the opinion of the promoters the syndicate will be useful at least in preventing further declines. If the syndicate guarantees loans, colour merchants may secure money from bankers, and thus hold their cargoes until the weaving industry revives.

Export of Raw Opium

THE London Gazette of Tuesday announces that the Home Secretary proposes to make the following regulation under the Dangerous Drugs Act, 1920. It will come into force immediately as a provisional rule: Each package containing raw opium for exportation otherwise than by parcel post, shall have marked on one side and on the top, by branding, stencilling or painting, in conspicuous and indelible block lettering, at least 2 in. in height, the words "Raw Opium. Net Weight," and the number of pounds of net weight, the whole enclosed by a rectangular border at least $\frac{1}{2}$ in. in width. Each package containing raw opium for exportation by parcel post shall have marked upon it in conspicuous and indelible block lettering the words "Raw Opium. Net Weight," and the number of pounds of net weight, the whole enclosed by a rectangular border. The marking shall be on the package itself and not on a label, ticket, or other thing attached thereto. No words, letters, or figures except those prescribed shall be placed within the rectangular border.

British Glues & Chemicals, Ltd.

Advantages of the Recent Amalgamation

THE statutory meeting of British Glues and Chemicals, Ltd., was held in London on Monday, Mr. W. S. Corder (chairman) presiding.

The company was incorporated on May 7, 1920, and the response to the prospectus was, the chairman stated, most gratifying. The whole of the preference share issue was allotted, and of the 1,000,000 ordinary shares offered 850,001 were allotted. As provided in the prospectus, 166,666 preference shares and 333,333 ordinary shares have been allotted to the vendors in part payment of the purchase price. There have been subscribed and paid for, subject to calls in arrear, 333,334 preference shares and 516,667 ordinary shares. Accounts have been prepared for all the vendor companies to May 29, 1920, from a draft combined balance-sheet at that date, and it appears that, including all the subscribed capital, and after paying the vendors the purchase prices for the various businesses, the liquid assets—that is, debtors, stocks, investments, cash at bank, &c.—exceed the liabilities by over £450,000, subject to the liability for excess profits duty from January 10 to May 29. The transfer of the properties from the old companies into the name of the new company has now been completed. The vendor companies are in process of voluntary liquidation, and new companies have been registered to preserve the names and goodwill.

Speaking of the advantages of the amalgamation, the chairman said the combined experience of the directors had already proved extremely valuable, and improvements in connection with plant, machinery and process were being put into effect and had already resulted in considerable economies.

"The co-ordination of the activities of the various works, conducted from head office, will," he continued, "in the opinion of your directors, be of the utmost value in developing the trade of the company. The research department has gone some distance towards solving a number of important problems in connection with our manufacture, and your directors are convinced that the work in progress will be of great value to the company. Our overseas trade is rapidly increasing, and owing to the variety of our products and our world-wide connections, in times of general trade depression the demand for our manufactures is much less affected than is the case in many trades. At the present time we have sufficient orders on our books to keep our works fully employed for a considerable period."

Referring to the opinion often created in the mind of the public that large amalgamations were effected in order to exploit the consumer by stifling competition and raising prices, Mr. Corder said that the policy of the company was to pay a fair market price for all raw material, to render every help and assistance possible to those responsible for the collection of this, and, by organising supplies, to reduce their transport charges to the minimum. Having done that, it would be their aim to produce cheaply and to improve their processes in every possible way, so that the very last ounce of value could be obtained from the raw material. The "British Glues" fats, fertilisers, glues and chemicals were well known and appreciated for their quality both at home and in foreign markets, and it was their object to maintain in every possible way the present high position occupied by all their products. In this connection, the company's research department was placed freely at the disposal of the company's customers in order that they might investigate their requirements, with a view to supplying the exact article required in every instance.

Negotiations are being completed for the purchase of a successful manufacturing business of a similar nature to this company in a part of the country which is not covered by the operations of British Glues & Chemicals, Ltd.

Water Gas Plants

MESSRS. DAVISON & PARTNER, LTD., 11, Carteret Street, Queen Anne's Gate, S.W. 1, write: In your editorial columns last week you refer, with some satisfaction, to the introduction of a special regulator for controlling the steam supply to water gas plants during the "run." Perhaps you will permit us to point out that we are the sole makers of this regulator, and we are already engaged in fitting up the apparatus on water gas plants in this country.

Company News

LAWES CHEMICAL MANURE CO.—Dividends of 7½ per cent. have been declared on the preferred shares, and 15s. per share on the ordinary shares.

WEBB'S CRYSTAL GLASS.—A dividend has been declared at the rate of 8 per cent. per annum for the six months ended August 31 on the preference shares, payable on September 1.

ROSARIO NITRATE.—An interim dividend has been declared of 5 per cent., free of tax, on account of the year ending September 30, payable on September 20.

CASSEL CYANIDE.—Dealings in 352,500 shares of 5s. each, fully paid, Nos. 1 to 352,500, have been specially allowed by the Stock Exchange Committee, and the shares are now included with those in which settlements have already been granted.

NAPARIMA OILFIELDS OF TRINIDAD.—The statutory report states that the capital is £200,000 in £1 shares. The number of shares allotted is 200,000, of which 100,000 are issued as fully paid, in consideration for the license granted by the Ste. Madeleine Sugar Co.; 100,000 shares are allotted for cash (10s. per share called). The total cash received in respect of these shares is £31,953.

PACIFIC PHOSPHATE CO.—Lord Southborough (deputy chairman), presiding on Wednesday at the annual meeting said that owing to the sale of the company's rights and properties in Ocean Island and Nauru it was obvious that their operations there must be brought to an end. As a matter of arrangement, they were still carrying on the business at Ocean Island and Nauru on behalf of the three Governments concerned, but when the Government Commissioners were ready to take over the business, or when the details of the transaction had been completed, this arrangement would terminate. The company had certain other interests besides those sold to the Governments, and it was intended to convene a meeting at an early date for the purpose of dealing with those interests and with the company's assets as a whole. As it might be some time before a distribution of the proceeds of the recent sale could be made, and having regard to the improved trading results for the first half of this year, the board proposed to pay an interim dividend on account of the current year simultaneously with the final dividend for 1919.

WASTE FUEL RECOVERY BRIQUETTE CO.—This company are offering for public subscription 47,500 10 per cent. (income-tax free) preference shares of £1 each at par, 25,000 ordinary shares of 1s. each at par and 25,000 12 per cent. (income-tax free) short term bonds of £1 each at par, payable as follows: Preference shares 10s. on application, 10s. on allotment; ordinary shares 1s. on application in full; bonds, 10s. on application, 10s. on allotment. The company, which has a capital of £50,000, has been formed to take over, recover, and convert into patent briquette fuel (household and industrial fuel and motor spirit), some of the largest colliery dumps or tips in the Midlands containing nearly four million tons of small coal, coke dust and oil shale now lying above ground as waste on the outskirts of one of the most important manufacturing and industrial centres of the Midlands, with buildings and site for works, way-leaves over and use of trolley track and broad gauge line to Great Western Main Line from the dumps; to convert such waste into patent fuel briquettes for household and industrial fuel; to recover the oil shale on the dumps and produce motor spirit therefrom; and to provide special plant and process for utilising colliery waste for the production of patent fuel.

The complete text (in Spanish) of a Decree, dated July 2, containing regulations governing the importation into, exportation from, and sale in Venezuela of OPIUM AND ITS ALKALOIDS, and of cocaine, may be seen at the Department of Overseas Trade, 35, Old Queen Street, S.W. The import, export, transit, purchase, sale and use of any kind of prepared opium (as defined in the Decree and in the International Opium Convention of 1912) is prohibited. Opium and its derivatives, cocaine and its derivatives, and synthetic preparations of any kind destined as substitutes for these substances may only be imported through certain ports (La Guaira, Puerto Cabello, Maracaibo and Ciudad Bolívar) under licence issued by the Director de Sanidad Nacional, and only by chemists, hospitals, and other duly authorised persons or institutions.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette

Companies Winding Up Voluntarily

MELBA CHINA CLAY CO., LTD. (in voluntary liquidation).—A general meeting will be held at the offices of Reeve, Parker & Co., 2, Coleman Street, London, E.C.2, on Tuesday, September 28, at 12 noon. A. G. Parker, Liquidator.

V. F. OIL SYNDICATE, LTD. (in voluntary liquidation).—A meeting of creditors will be held at 110, Cannon Street, London, on Thursday, September 2, at 11 a.m. Creditors' claims on or before October 1 to liquidators, the Prudential Investment Co., Ltd, at the above address.

WESTERN COUNTIES & GENERAL MANURE CO., LTD. Liquidators, F. M. Boswarva, 6, Gordon Terrace, Plymouth, and W. J. Robins, Abbey Park, Keynsham, Somerset.

Order made on Application for Discharge

NEWTON, GEORGE EDWARD ELLIS (described in the Receiving Order as George Edward Newton), 74, Great Tower Street, London, lately residing at 203, St. James' Road, Croydon, Surrey, wholesale chemist. Discharge suspended for three years, and that he be discharged as from July 23, 1923. Date of order, July 23, 1920.

Mortgages and Charges

[NOTE.—*The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, created after July 1, 1908, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges which would, if created after July 1, 1908, require registration. The following Mortgages and Charges have been so registered. In each case the total debt, as specified, in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.*]

OCEAN OIL CO., LTD. (formerly EXPRESS OIL CO., LTD.), LONDON, E.C.—Registered August 11, £12,000 debentures (filed under sec. 93 (3) of the Companies (Consolidation) Act, 1908), present issue £7,250; general charge, *£700. November 20, 1919.

RUSSIAN KUBAN INDUSTRIAL & PETROLEUM CO., LTD., LONDON, E.C.—Registered August 10, £15,000 1st mortgage registered debenture stock, secured by Trust Deed dated July 22, 1920; general charge, *£1,000. December 8, 1919.

Satisfaction

OCEAN OIL CO., LTD. (formerly EXPRESS OIL CO., LTD.), LONDON, E.C.—Satisfaction registered August 16, £1,000 registered April 18, 1913.

County Court Judgments

[NOTE.—*The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court judgments against him.*]

THORLEY, W., 27, Crouch Hill, N.4. chemist, £17. 7s. 4d. July 19.

BEVAN, MARTIN, I., 99, Woodfield Street, Morriston, chemist, £20. 5s. 1d. July 19.

Bill of Sale

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1882 and under the Act of 1878. Both kinds require re-registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

HANKINSON, ALFRED MURCH, 59, Grosvenor Road, Ilford, chemist. Filed August 18. £300.

TEAK VATS

Selected, or sample on our approval terms, worth double. Overall sizes, 37 $\frac{1}{2}$ " by 35 $\frac{1}{2}$ " by 20", £10.0 each, with cover, £5 5 0, material 2" thick. Smaller, 20 $\frac{1}{2}$ " by 18 $\frac{1}{2}$ " by 19", £1 2 0 each, with cover £1 7 0, material 1 $\frac{1}{2}$ " thick. Second-hand Huts and Sheds, also New and Second-hand Timber, Plywood, Woodwork of all descriptions.

JENNINGS, Ltd., 889, Pennywell Rd., BRISTOL

RADIUM

PURE SALTS, OR IN SOLUTION
LUMINOUS COMPOUND, ALL GRADES
MEDICAL APPLICATORS, ALL KINDS
ELECTROSCOPES AND APPARATUS

TESTING DONE. STANDARDS SUPPLIED

F. HARRISON GLEW, 156, CLAPHAM ROAD, LONDON, S.W.9

WOODHOUSE & MITCHELL, Ltd.,
ENGINEERS, IRON AND BRASSFOUNDERS,
BRIGHOUSE, YORKS.

AUTOCLAVES, JACKETED PANS,
BLOWING EGGS, EVAPORATORS,
MEASURING-POTS, SCRUBBERS,
MIXERS, AGITATING GEAR, &c.

Telegrams: "Woodhouse, Brighouse." Phone: 7.
ESTABLISHED 1867.

**SALICYLIC ACID
B.P. and Technical.****ASPIRIN B.P.**

Powder and Tablets. Finest Quality. Lowest Price.

PIERSON MORRELL & CO., LTD.
The Original British Aspirin Makers. 25, Queen's Rd., BARNET, ENG.
Telephone: Barnet 723. Telegrams: Pierson, Morrell, Barnet.

W. P. THOMPSON, F.C.S., M.I.Mech.E.

W. P. THOMPSON & CO. 12, CHURCH STREET,
CHARTERED PATENT AGENTS. LIVERPOOL.

H. E. POTTS, M.Sc.Hon.Chem.

G. C. DYMOND, M.I.Mech.E.

J. W. ARMSTRONG, M.T.I.

BONE ASH

PUREST AND FINEST.

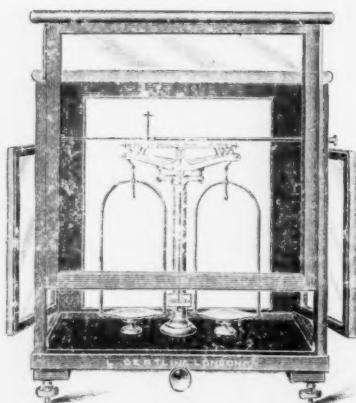
 Highest Percentage of
Tricalcic Phosphate.

THE PURE BONE PHOSPHATE & CHEMICAL CO., LTD.,

27, KIRKGATE, NEWARK, ENG.

AN
"OERTLING"
BALANCE

Is the Most Important Part of the Equipment
of a Really Up-to-date Laboratory.



COLONIAL BUYERS SHOULD SPECIFY
"OERTLING" BALANCES IN THEIR INDENTS.

MANUFACTURED IN LONDON

BY

L. OERTLING, LTD., E.C.1.

ILLUSTRATED CATALOGUE POST FREE.

